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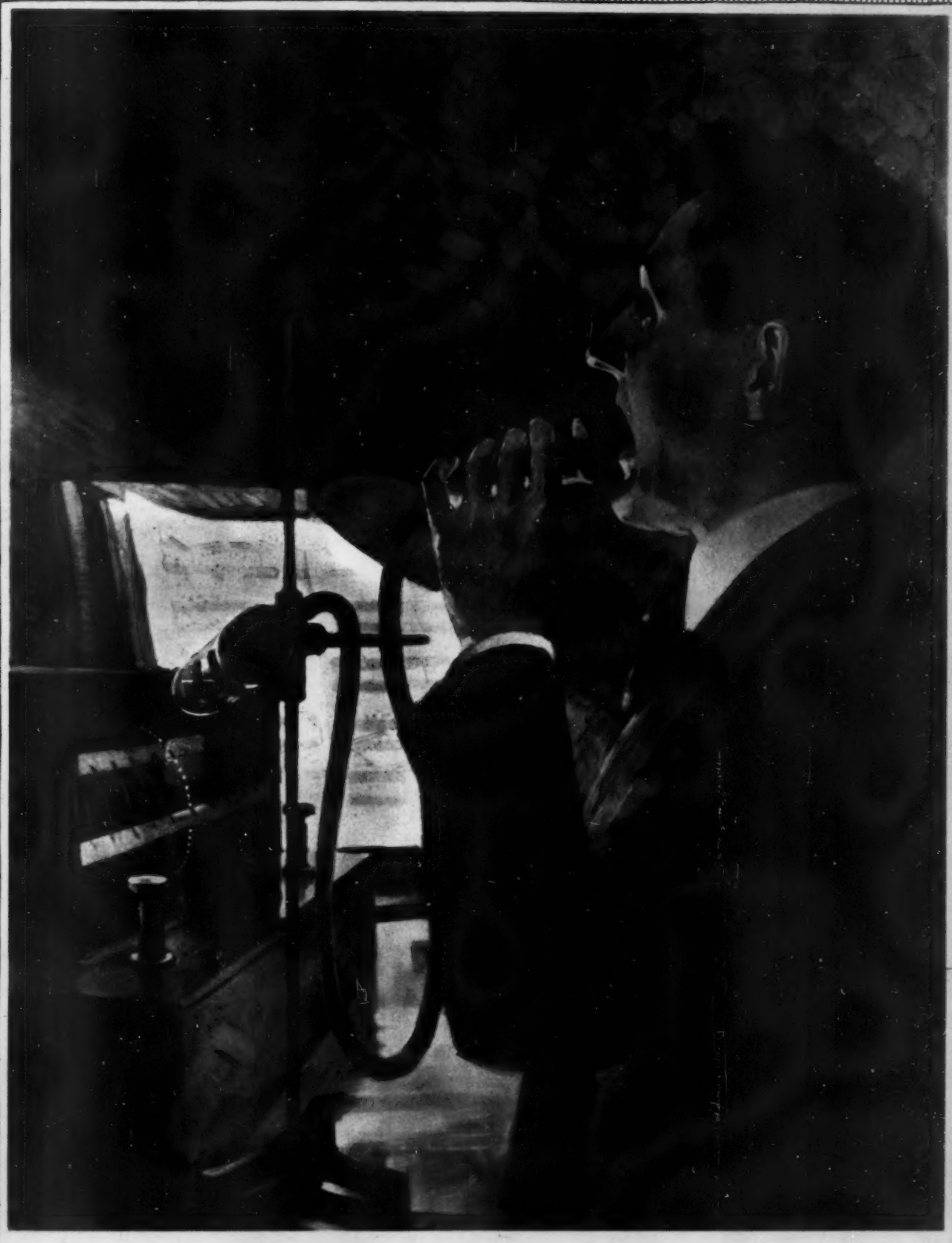

LETTING THE EYE TRAIN THE VOICE—[See page 410]

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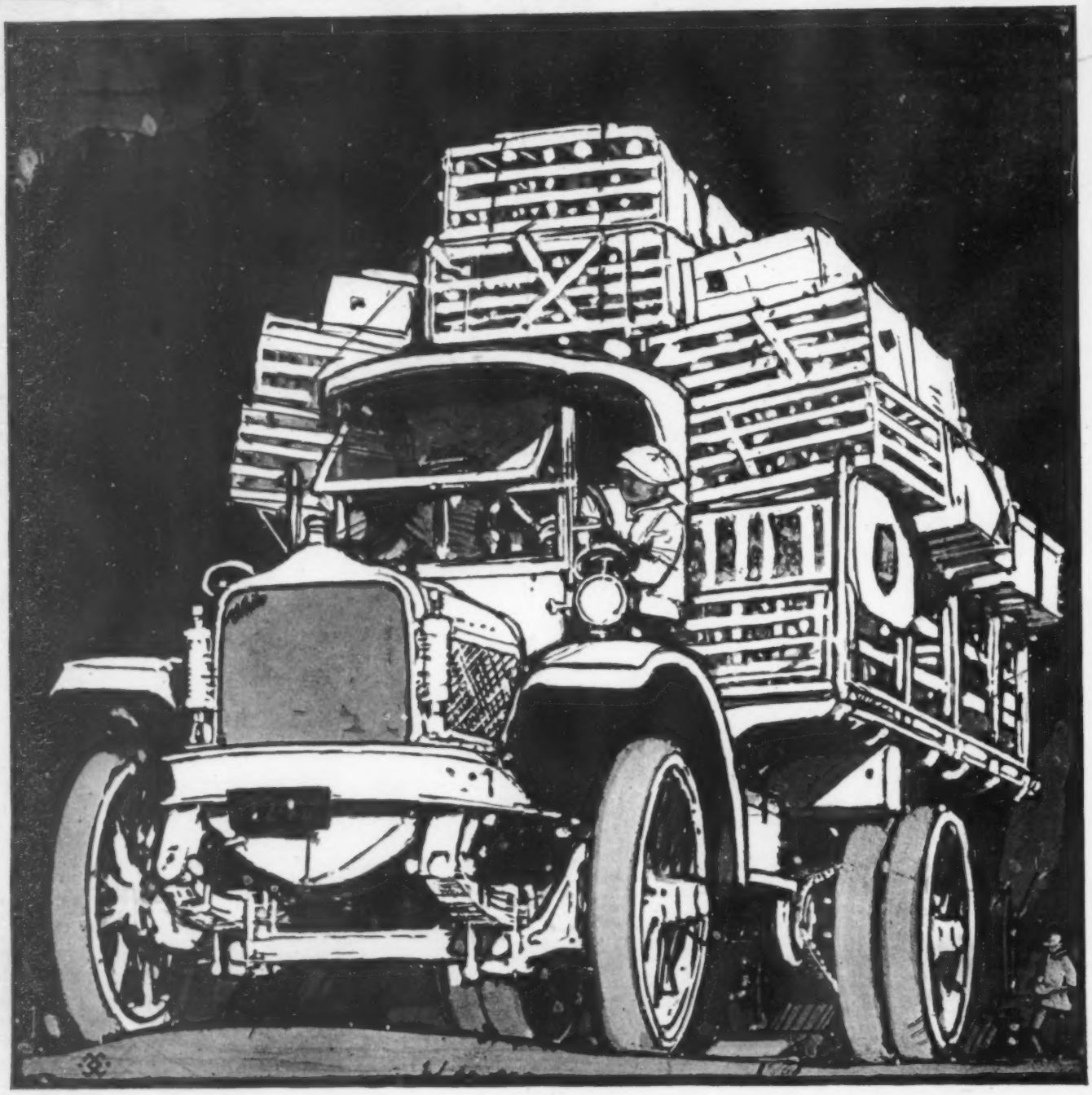

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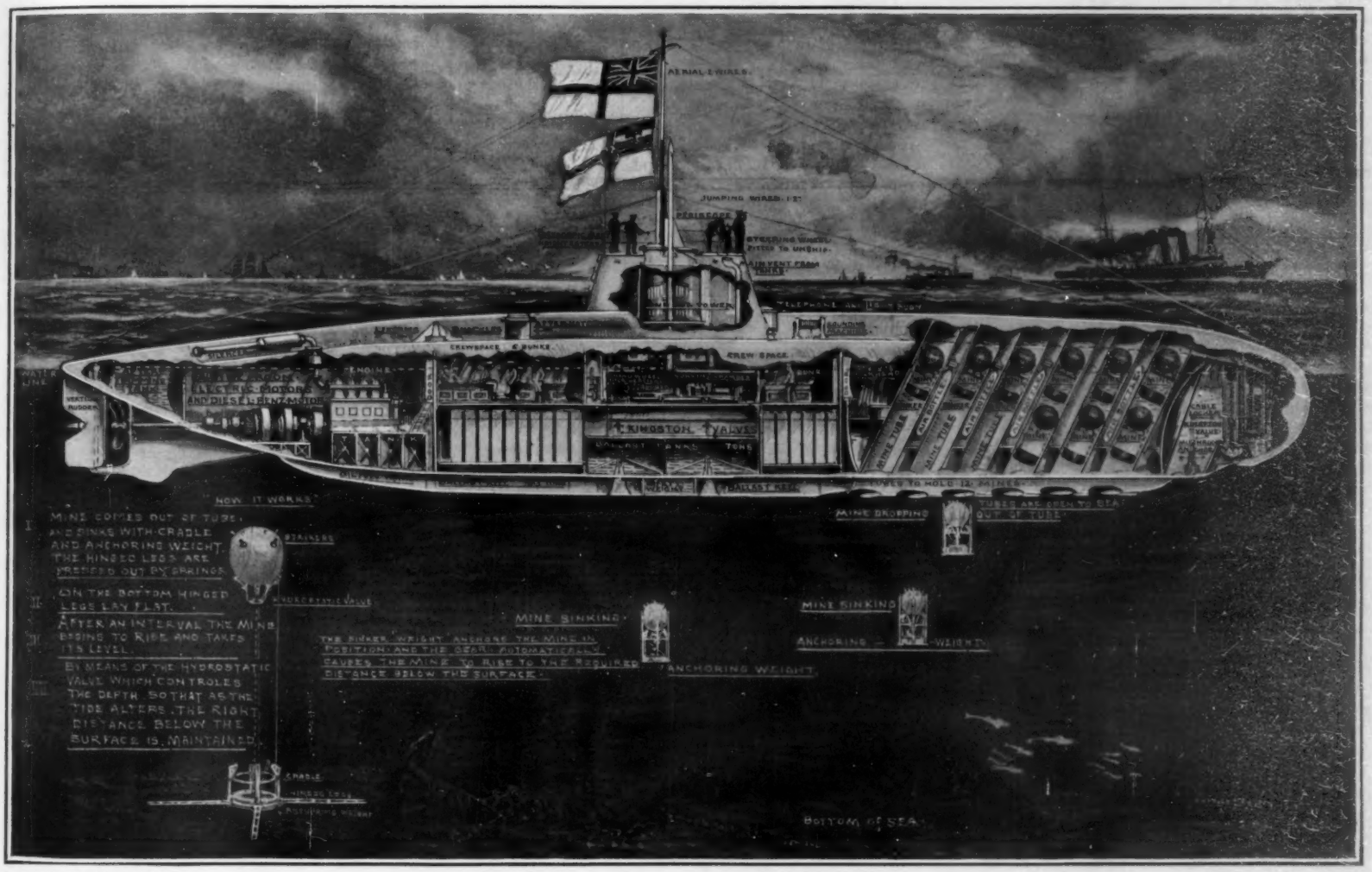

Official drawing of the captured German submarine, U. C-5. Published exclusively in the Scientific American by permission of the British Admiralty

The Captured German Mine-Laying Submarine

IN our issue of Aug. 19, 1916, we presented photographs of the captured German U C-5, a mine-laying submarine which was taken by a British destroyer off the East coast of England last April.

By the courtesy of the British Admiralty, we are now enabled to present the above official drawing, showing in considerable detail the construction and interior arrangements of this little craft. The U C-5 is diminutive, if we compare her with the latest submarines of from 800 to 2000 tons displacement; but, as may be seen from the engraving, she is big enough to carry a dozen mines in her launching tubes, and, indeed, is credited by the British with having made as many as a score of trips from her base at Zeebrugge, on the Belgium coast. Her dimensions are given as about 110 feet length, 11 feet beam and 200 tons displacement.

The mines are carried in the forward part of the boat in six vertical tubes, extending clear from the top to the bottom. At the deck, each mine tube is covered by a grating, and its lower end is open to the sea. The tubes are inclined aft at about 25° from the vertical—this to insure that a mine will leave the ship in a direction opposite to that in which the boat is traveling. Each mine is held above its anchoring weight by four sets of angle-irons, and in these there are recesses which are engaged by plungers in the wall of the tube, which serve to hold the mine in place when it is not in use. There are two mines in each tube, one carried above the other.

When it is desired to drop a mine, the plungers of the lower mine are withdrawn by means of connections from the conning tower, and it drops through the bottom of the boat. The upper mine can be released in the same way.

The whole mechanism as thus dropped into the sea, consists of a heavy bottom disk, forming the mine anchor, and above this a spherical case containing the high explosive. These two parts are held in their relative positions by the four hinged angle-irons above referred to. When the mine strikes the bottom, the four arms are thrown out into a horizontal position by means of springs. The mine proper contains a relay device, which insures that the mine shall not become buoyant until sometime after it has left the launching tube. The object of this is to make sure it will immediately sink; otherwise, its sensitive contact points might touch the bottom of the submarine. There is a chemical control for holding the wire rope, connecting mine and anchor, wound up upon its drum, until the proper time for the mine to rise; which it does under its newly-acquired buoyancy. The depth at which it shall float below the surface is determined by a hydrostatic valve carried in the spherical mine proper.

The U C-5 carries no guns or torpedo tubes. She is driven by a Deisel-Benz, 4-cylinder engine, operating a single propeller. Forward of the mine-launching tube are the chain-locker and two anchors, one of the mushroom and the other of the fluke type. The flasks carried between the launching-tubes contain compressed air. Aft of the tubes is a heavy bulkhead. Then follows a compartment largely given up to storage batteries.

Abaft the next bulkhead are the ballast tanks and the working chamber, which latter is located immediately below the conning tower. In the next compartment are 70 storage batteries with living quarters above. Abaft the next bulkhead is the engineroom and the aftermost compartment is used as a trimming tank.

The boat is built with a double skin and it has reserve buoyancy tanks on each side. A light sheet-steel deck is built above the boat, and beneath this are the motor silencers, sounding machine and other gear. The oil fuel tanks are in the double bottom. There is evidence that the boat was built in three sections to enable it to be carried by rail, canal or otherwise.

Molybdenum as a Steel Alloy

THE business of producing alloy metals, though a virgin field, has sprung into especial prominence because of the necessity of husbanding the supply of iron. The steady advance in the price of ore gives the strongest evidence of the increasing scarcity of this metal; and the greatest economy in prospect is the use of the rare mineral alloys which produce such a radical increase in strength coupled with reduction in weight of material consumed. The use of tungsten and vanadium in this conection is more or less of an old story; and the producers of molybdenum now claim for it a future far out-reaching that of either of its competitors.

It is stated that the great guns with which Germany did such destruction when her artillery preparation took the world by surprise in 1913 were molybdenum guns; that, containing three to four per cent of this substance, their life was twenty times that of the ordinary gun. It is estimated that at the present market price the use of a 3¾ per cent molybdenum alloy would increase the cost of a twelve-inch gun about 25 per cent, while increasing its useful life 2,000 per cent. And in rifle barrels for high power powder, the strength can be increased even though the weight be materially reduced.

In the form of molybdenite—the disulphide—and wulfendite—the molybdate of lead—this metal is found in Colorado, Arizona, Washington and Maine, and extraordinary deposits are being uncovered in the Province of Ontario, so that for it, at least, we shall probably not have to depend upon European sources of supply.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

How Germany May Fail

IF Germany is to lose the war, as the nations which compose the Entente firmly believe she will, the question arises—and it is being asked just now with increasing frequency—which is the particular link in the elaborate chain of her defenses that will be the first to snap; for there can be no denying the fact that the chain is, even to-day, under great tension, and that the stress will continue to increase, not suddenly, but rather with the steady accumulation shown by a testing machine in the laboratory as it reaches the elastic limit of the steel bar which it holds in its grip, and finally tears the unwilling fibers apart in complete rupture.

The chain of a nation's defensive strength in a war of the magnitude and complexity of that being waged in Europe is exceedingly complex and is made up of many elements, military, financial, industrial, economic, human and moral. For a nation to be beaten, it is not by any means necessary that the military link shall be the first to let go. A nation, or group of nations, thrown into a state of siege such as that which now obtains or will soon obtain in Germany and Austria, may be brought to the point of surrender either through starvation, or financial collapse, or failure in the supply of its war material in the way of guns, shells and general equipment, or, finally, through its failure in man-power—its failure to put into its fighting line sufficient men to resist the pressure of the enemy.

1. STARVATION. So far as the threat of starvation is concerned, the indications are that this will never be the decisive factor in this war. That it will be a contributory element, irritating, discouraging, and weakening, cannot be denied; but the Central Powers will never be starved into surrender. There is sufficient good arable land within the confines of Germany and Austria, and there will be, even when the Turks and Bulgarians have been cut off and the chain of investment by sea and land is complete, to enable the Central Powers to raise all the food necessary to keep the populace alive and in fair health, and maintain the armies themselves in good fighting condition.

2. FINANCIAL COLLAPSE. Nor is it likely that Germany will be brought to her knees by any sudden financial collapse. The plan which she has adopted for paying the costs of the war, has proved thus far to be wonderfully effective, and it will continue to be effective just as long as the patriotism of the German people and their faith in the future of Germany, make them willing to accept the German Government's paper. The German leaders have pointed triumphantly to the fact that the expenses of the war have been cheerfully borne among the German people themselves; that unlike the Allies, they are purchasing nothing abroad. In a sense, it may be said that the German is taking the money out of one pocket and putting it into the other. The money which the Government pays to the contractor for guns, shells, equipment, motor trucks, and clothing and food for the Army, the contractor returns to the Government, taking in exchange war bonds, drawing such and such interest and redeemable after a definite period of years. In the earlier stages of the war, as the Government indebtedness began to assume staggering proportions, the docile German people were told there was no cause for alarm, since this indebtedness would be liquidated by the vast indemnities which would be collected from their already-beaten enemies. That successive German loans should be so freely subscribed under the soothing syrup of this delusion, the outside world was well able to understand; but now that the dream of indemnities has passed away, one cannot but admire the confidence and patriotic devotion with which the German public still continues to pour its offerings into the German Government treasuries. There is little promise of any early breakdown in the financial operations of the Government as thus carried on. Even when the German people see the spectre of ultimate defeat lifting its head in the far distance, they will realize that their failure to feed the National Treasury would simply be to convert a possibility into a present disaster.

3. LACK OF GUNS AND MUNITIONS. As in the matter of food, so in respect of munitions, the Central Powers possess within their borders a sufficiency of the raw materials, coke, coal, iron ore, etc., necessary to keep their great gunshops and munition factories going indefinitely. Nitrogen they can get from the atmosphere; and, apparently, they have developed some substitute for cotton. Powder for the guns and high explosives for the shells, moreover, they are producing and probably will continue to produce in sufficient quantities for the day's need; and even in respect of copper, the fact that the Allies are finding the fragments of aluminum banding, which has come over with the German shells, suggests that they are able to eke out the limited supply of copper by this means. Moreover, in the copper utensils throughout the two empires, to say nothing of copper roofing and piping, there is a reserve of great magnitude. As a matter of fact, in spite of the enormous expenditures of shells and heavy wear and tear of guns during the two years of the war, the munitionment of the Central Powers shows no signs of diminution. It has been overtaken and is now being exceeded by the Allies; but that the fighting front will give way, as did the Russian lines last year, because of a shortage of munitions, may be dismissed as a possible determining element in the ultimate German defeat.

4. MAN-POWER. It is when we come to the question of man-power, that is to say of the ability of the Central Powers to replace their losses in men by fresh material of sufficiently tough and durable quality to stand the stress of front-line fighting, that the ultimate break-up of Teutonic resistance is seen to be inevitable. The Teutons can produce within their own frontiers sufficient food-stuffs to feed the people and fighting-lines indefinitely. So, also, provided there is perfect coöperation between the people and the government, they can finance the war indefinitely, without going outside their own borders for assistance. From Mother Earth and the atmosphere above it, they can gather the raw materials for munitionment and other supplies of war of a material kind, in sufficient quantities to keep their well-organized factories going as long as the war shall last. But they cannot, in equal proportion, in the absolutely indispensable proportion, for their final success, produce in necessary amounts and necessary quality the human fighting material. The officially-admitted losses of Germany during the two years of war is about three and a quarter millions of men. It is well known that, though in the earlier months of the war, the official lists were accurate, subsequently, as the stupendous and hopeless magnitude of the task Germany had undertaken became evident to her, only a certain percentage of her losses has been published. Indeed it is probably pretty near the truth to say that her losses to date are well up to the four million mark. That represents approximately a loss of two million men per year—and the bloodiest of the fighting is undoubtedly yet to come. In order to be conservative in this estimate, let us suppose that the total loss is only one and a half millions per year. This rate will have to be made good in equal amounts if the German lines are to be held at their present strength. What then are her acknowledged sources of supply? It is generally accepted that the maximum of fresh troops, young men of seventeen and eighteen years of age, which she can put into the field annually, is six hundred thousand. It takes but the application of very simple arithmetic to show that there is going on a steady and very serious dwindling of the maximum amount of good fighting material that Germany has and will have at her disposal. That she is feeling the pinch of necessity is strongly suggested by the unbroken series of successful drives which are being made by the British and French on the Somme front, and by the fact that recently, at Verdun, the French were able to win back in a single day territory which it had taken months for the Germans to wrest from France earlier in the year. It is believed with very good reason that the armies under Falkenhayn and Mackensen, which are overrunning Roumania, were not drawn from the reserves but from the western and eastern fronts. Estimated on a basis of ten per cent of the population available for military purposes, the Allies can put two men into the field for every one maintained there by the Central Powers. If the losses on each side are approximately equal, or even if they are one and a half to one in favor of the Central Powers, it is again a simple matter of arithmetic to demonstrate that the Entente armies in men, as in munitions, must ultimately possess a crushing superiority over the Central Powers.

The Technical Training of Foremen

WITHIN the past 25 years, there has been created a growing demand from industries for young men with chemical training. As a result of this demand, many excellent chemical courses have been established in our universities and technical schools, the graduates from which have found a ready welcome in nearly every line of manufacturing. These young men, for the most part, have been employed as analytical chemists. The demand for such men has been gradually increasing, until, at the present time, there is hardly a sufficient number available to meet the demands.

As our manufacturing processes have become more complicated within recent years, there is another problem which confronts us—that is, the ability to handle these complicated processes in an intelligent manner in the works. In other words, we have come to realize that we must have not only research chemists to work out new processes, and technically trained men in our laboratories to test the materials purchased and the products manufactured, but likewise men in our plants to make these products who are also technically trained. That is to say, we must make provision for the training of our foremen. Many a process has been pronounced a failure, and many a product ruined, because unintelligent supervision was exercised during the preliminary trials.

That such a condition exists was felt by the trustees of Pratt Institute, in Brooklyn, and, as a result, in 1905, a course in applied chemistry was established, which has for its aim the training of young men for foremanship positions in our growing chemical industries. In organizing the work the problem was attacked from an entirely novel standpoint. It was believed that, to train men for factory work, it was necessary that they have factory experience. It being impossible to put the student into actual factories, the next best method was adopted—that of building model factories at the school, where the student might handle materials on a sufficiently large scale to approach commercial conditions.

In the original plan, the five model plants selected were a soap factory, a paint factory, a chemical works, dyeing equipment, and tannery. Since the inauguration of the course, however, the scope of the work has greatly enlarged; the equipment in all of the original plants has been materially increased, and several new plants have been installed—a dry-color and ink works, a varnish equipment, and an intermediate and dyestuff plant.

In working in these model plants, the students are assigned in groups, one of the members being foreman. The equipment is of such a character that marketable products can be produced, and, being of a high standard, they find ready sale. Not only does this afford a source of funds, but the student's knowledge that his products are destined for commercial use adds greatly to the atmosphere. By working in the model plant, the student becomes familiar with the handling of machinery, gains experience in the control of men, and acquires confidence in his own ability to work with materials which have a money value. He also learns that to spoil a batch of goods means money lost, that to make an inferior article lowers the efficiency of his plant. In carrying on this work, the foreman must also keep a record of all operations, the cost of raw material, labor and depreciation of plant, and the interest on the investment.

The object of the course, as stated above, is to train foremen, and so the instruction is not treated as an engineering problem, the idea being simply to fit young men to handle practically every kind of a piece of apparatus and machine that is found in any chemical manufacturing plant. Of course, it should be understood that the work in the industrial laboratory is only a part of the instruction given, other essential subjects being necessarily included. A close investigation of the subsequent careers of the graduates of this school makes it quite clear that it is making good in the field which it has tried to fill.

Tomato Plants and Phylloxera

A NOVEL method of ridding vineyards of the scourge of phylloxera is suggested in *Horticulture Nouvelle*. According to this an Italian viticulturist having a vineyard badly infested with phylloxera planted tomato vines between the rows, in order to obtain some sort of return from the ground. By the time these had attained a certain height he noted with surprise that his vines were putting forth fresh shoots and displaying a vigor which had been long absent. He thereupon pulled up some of the tomato plants and found a considerable number of dead insects around their roots. Apparently the tomato plants elaborate a poison which acts as an insecticide. A commission of experts in Italy is experimenting along this line, to see whether the tomato will furnish a specific for the cure of phylloxera.

Naval and Military

Corduroy Roads for Heavy Artillery and Freight.—The roads, so-called, in much of Poland are mere tracks of loose sand, impassable for heavy artillery and loaded motor trucks. The Germans got over the difficulty by cutting down the scrub pine which cover the hills and building corduroy roads of transverse logs. This they covered first with smaller fir branches and then with a layer of sand. This gave a firm but elastic roadway, wide enough for a single line of trucks. The returning empties took to the sand on meeting the loaded traffic and artillery.

A Vote on Universal Service.—By vote ranging from 120 to 1, to 15 to 1, the leading commercial and trade organizations of the country, composing the Chamber of Commerce of the United States, have come out solidly in favor of a compbrehensive plan for preparedness. On the subject of Universal Military Training, 359 commercial and trade organizations, representing 43 states took part in the ballot. The test of opinion was widespread and the resulting vote was overwhelming—889 to 56—in favor of the principle that every man in a democracy ought to be not only willing, but able to protect his country.

The Enlisted Force of the Navy.—The total enlisted force of the U. S. Navy in 1915 was 52,561. Of these 47,908 were native-born; 5,056 foreign-born. Fifteen states furnished 65 per cent of the force. New York State furnishes the largest number of American-born seamen, namely, 6,719. There is no difficulty in getting enlistments; but the high standard causes the majority of applicants to be rejected. Thus in 1915 there were 102,561 applications for enlistment; but only 17,704 were enlisted, and, of these, 6,291 were re-enlistments. Of the rejections, 61,000 were for disability and 17,000 for other causes. For the year 1916, 68,000 men are authorized.

Big Battleships the Cheapest.—The winner of a prize essay published in the current issue U. S. Naval Institute Proceedings shows that, in the last analysis the big battleship is the cheapest battleship. Comparing the old 14,000-ton "Mississippi" with the new 27,000-ton "Texas," he shows that the former with a broadside weighing 5,480 pounds cost only one half as much as the "Texas," whose broadside weight is 14,000 pounds; yet these very figures prove that the cost per pound of broadside was $1,070 in the older ship and only $720 per pound in the big ship. Moreover the cost of yearly maintenance per pound of broadside was more than twice as great for the smaller ship.

The Big Battleship the Better Fighting Machine.—The same author carries his argument further, and shows that big ships are not only proportionately cheaper to build and maintain, but are in every particular superior fighting machines. "No one can dispute that as the size of the ships increases, so, proportionately, increase all those military features—size of guns, speed, seaworthiness, steaming radius, protection, and seaworthiness, which are the essential components of the well-balanced ship."

The Machine-gun Army Board.—When the board recently announced by the War Department, which is composed of seven officers of the Army and two well-known civilians of long experience in the mechanical and industrial world, has made its report, the machine-gun controversy should be settled for a long time to come. The board was suggested by the "Army and Navy Journal," which enumerated the following desirable elements in a machine-gun: dependibility, simplicity, mobility, economic superiority and ability to stand the test of actual experence. The gun should show dependibility under adverse climatic conditions, simplicity in regard to the fewest number of parts, positive ammunition feed, quickness of getting into action, few men required to serve the gun, amount of time and material for minor repairs, and finally, the choice should take account of machine-gun record in the present war.

The Allies' Answer to the Austro-Germans' Big Guns.—It was inevitable that during the past two years of preparation by the Allies to meet the preponderating artillery of the Teuton armies the French and British would pay particular attention to the construction of big guns, both of the howitzer and long-range types. These guns have now made their appearance on the French front in numbers so large that it is claimed the German and Austrian superiority has disappeared. France and Great Britain have built their own guns; Italy was provided with numerous batteries of 12-inch pieces at the time she entered the war, and Russia is now fairly well supplied in this respect, thanks to the assistance of the Japanese government's arsenals. A considerable portion of the big guns on the French and British fronts are mounted on special railroad cars, provided with extensible brackets and struts, which serve to take the shock of discharge. It may almost be said that the war has become the battle of the big gun.

Science

Effects of Oaks on Olive Trees.—It is a well known fact that olive trees are generally stunted in their growth when in the vicinity of oak woods. This phenomenon has been investigated in Italy by L. Petri, who made a series of pot cultures in which young olive and oak plants were grown a few inches apart. The net result of his experiments is that the failure of olive trees near oaks is due to the impoverishment of the soil by the latter, rather than by the transmission of any species of infection.

Protecting a Rare Plant in Southwest Africa.—The British administration in Southwest Africa is keeping up the miniature park formerly maintained by the German government in the vicinity of Welwitsch, on the Windhuk line, for the preservation of the interesting plant *Welwitschia*. This plant, which bears only two leaves throughout its existence and grows for a century or more, is rare and of limited distribution. It is especially interesting from an ecological point of view, on account of its perfect adaptation to life in the desert belt where it is found. It was named in honor of Dr. F. Welwitsch, who discovered it in 1865.

Bear Island, lying about 300 miles south of Spitsbergen, in the Arctic Ocean, promises to become an important source of coal, and has the advantage over Spitsbergen that cargoes may be despatched throughout the year. An extensive coal field was worked there last summer. It is reported that the Norwegian government intends to establish a wireless and meteorological station in the island, as it has done in Spitsbergen. Bear Island lies at a meeting-point between a cold ocean current from the northeast and the Gulf Stream Drift, and is usually shrouded in fog. The highest point is Mount Misery (1,759 feet). Countless seafowl inhabit the rocky shores and the "bird rock," on the south side of the island, is said to be the largest colony of its kind in the Arctic regions.

Alpine Haze Due to the War?—Dr. Julius Maurer, director of the meteorological service of Switzerland, reports that since the middle of last July the atmosphere in the high Alps has shown marked optical deterioration, as indicated by the extension of the glow around the sun to which Maurer applies the term "aureole," reaching a diameter of 140 deg. by the end of August. A Bishop's ring, or large corona due to dust, was visible August 3rd-4th. Phenomena of this character seen in 1883-84, 1902-03, and 1912 were attributed to volcanic dust from the explosive eruptions of Krakatoa, Pelé and Katmai, respectively, but no violent volcanic eruptions have been reported this year. The question has been raised whether the cumulative effects of gunfire in the course of two years of war may be equivalent to those of a volcanic eruption in charging the upper air with dust.

Unexplored Areas in Canada.—A recent paper by Mr. Charles Camsell, of the Geological Survey of Canada, corrects the common impression, prevalent even among Canadians, that comparatively little territory remains to be explored in Canada, apart from the Arctic islands. The impression probably arises from the fact that the maps no longer show large tracts containing no detail, or marked "unexplored." The fact is, however, that an immense amount of material entering into the map of Canada is based upon vague and untrustworthy information. Mr. Camsell makes an estimate of the amount of unexplored continental territory in the Dominion, in which he follows the plan of considering as explored a strip of 15 miles on each side of an explorer's route. On this basis the unexplored area amounts to about 901,000 square miles, and this does not take account of blocks under 4,000 square miles in extent. This is about 28 per cent of the total area of Canada, excluding Arctic islands. A period of rapid progress in exploration will, however, probably follow the war, as recently constructed railways have greatly facilitated access to the unknown regions.

The "Daylight-Saving" Experiment.—Although it is too soon to pronounce definite judgment as to the success of the experimental use of "summer time" in many European countries last summer, the reports thus far at hand are quite uniformly favorable. The United States consul general at Vienna reports that the Viennese people consumed $142,000 worth less gas under the new time schedule. In England the plan is said to have given general satisfaction, even the farmers, who at first opposed it, having become reconciled. The British government has appointed a committee to consider the social and economic results of the experiment, and to report whether it seems advisable to perpetuate the plan, with or without some modifications. At this year's meeting of the British Association Prof. H. H. Turner, Savilian professor of astronomy at Oxford, justified the innovation from a scientific point of view, while Prof. J. Perry, who admitted that he had formerly opposed the scheme without giving it due consideration, declared himself a convert.

Electricity

An Electric Hand Mirror is now included among the latest electric novelties. This mirror contains a battery in its handle and a small electric bulb just below the reflecting surface, so as to throw the light on the face of the user. The new mirror is said to have a wide variety of uses to which it is peculiarly adapted.

Electric Furnaces in the United States.—Dr. J. A. Mathews, in an informative paper read before the American Iron and Steel Institute, stated that the furnaces already installed in the United States represent the utilization of 125,000 to 135,000 electrical horse-power. This represents an output of about a million tons of ingots or castings per annum. The Héroult system represents some 70 per cent of the total tonnage.

Apparatus for Testing Magnetos.—A method of testing magneto apparatus is described in a recent issue of *La Revue Electrique*. The magneto to be tested is caused to produce sparks between platinum points in an atmosphere of nitrogen enclosed in a glass bulb, across which there also extends a resistance wire in an independent circuit. The expansion of the enclosed gas, due to the heat generated by the sparks, is measured by the movement of a mercury column in a U-tube, one end of which opens into the bulb at the bottom. The apparatus is calibrated by means of the resistance wire. The results of experiments are given, showing the variation in the energy per spark. This rises to a maximum, and then decreases as the speed of rotation is increased.

Adjustable Electric Pocket Lamps.—It is learned from *The Electrician* that a new form of electric portable lamp, the light from which is adjustable, is being brought out in Germany. A small spiral resistance in series with the lamp and switch is mounted above the battery. The resistance can be readily varied by the motion of a small knob at the side of the case, the brightness of the lamp being thus altered within the limits of maximum intensity and a dull red glow. This enables current to be economized when only a small amount of light is needed, prolonging the life of the lamp and battery. The resistance is also useful in preventing the tendency to over-run the lamp unduly when a new battery is substituted for the old one.

Long-Distance Telephones for Canary Islands.—The estimates of material needed for the construction of a long-distance telephone system connecting Santa Cruz de Teneriffe, capital of the Canary Islands, with several smaller towns in Teneriffe Island have just been completed. The work will require more telephone-construction material than any previous project in these islands. The longest distance between talking points is figured at 150 kilometers (93.2 miles). The number of instruments expected to be brought into use for long-distance work is 119. The actual construction will be done by the Spanish government, department of telegraphs, under the direction of the Cabildo Insular de Teneriffe.

Electricity in Russia.—According to the *Journal of Commerce*, a committee charged with industrial affairs has recently made an inquiry as to the volume of electric supply which will be available after the war for industrial requirements in Russia. The figures prepared by the committee show that there is need for a rapid increase in the means of generating electric current in Russia. It appears that in European Russia the total capacity of 93 stations is 79,553 kw. The 12 Siberian stations which have answered the inquiry report a total capacity of 9,500 kw., and five stations in the Caucasus 3,026 kw. It is stated that some 30,000 horse-power is available for new undertakings able to take an uninterrupted supply, and about 60,000 horse-power is available for works requiring only an intermittent supply of current.

A Recording X-Ray Spectrometer.—In an article in the *Physical Review*, Mr. A. H. Compton describes a recording X-ray spectrometer, by means of which a continuous record can be obtained of the ionisation produced by a beam of X-rays reflected from a crystal as the angle of the crystal is varied. A spurious and irregular current in the ionisation chamber was investigated and found to be due to a slight radioactivity within the ionisation chamber. Methods are described whereby the effect of this radioactivity may be considerably reduced. The X-ray spectrum of tungsten was examined in some detail. In addition to the seven lines already known, an indication was found of six others, two of which are, however, somewhat uncertain. The wave-lengths of the different lines were carefully determined. The relative intensities of the different order reflections of the same line are proportional to the areas under the humps produced in the record of the spectrum line; and the relative intensities of the first three orders in the spectrum from rock salt were determined by measuring these areas. The observed intensities of the different orders indicate that polarization occurs where a beam of X-rays has been reflected by a crystal.

Our artist's conception of the screen of rotating discs discharged in the path of an attacking torpedo

Torpedo Screen for Ships Under Way

Building Up Wall of Whirling Plates in the Path of a Submarine Torpedo

By John B. Flowers, Electrical and Mechanical Engineer

OUR READERS will doubtless remember the author of this article as the inventor of some very ingenious machines and devices. Mr. Flowers' first experiments with the voice-operated typewriter were described in the SCIENTIFIC AMERICAN *several years ago. In the present article, Mr. Flowers' outlines an invention which marks a radical departure from his previous lines of research. The publication of this article is not to be understood as an endorsement of the invention. We present it to our readers because of the originality of the plan and the ingenuity of the mechanism employed.*—EDITOR.

THE submarine torpedo speeding on its errand of destruction is not an imperceptible missile. It is an automobile boat driven by a compressed air motor, and although the boat itself is hidden, the exhaust of the motor throws out a wake that traces the course of the racing engine of death, giving warning of the impending collision.

It is admitted by torpedo experts that except in very rough water the white wake may be seen at a distance of 1,000 to 2,000 feet by carefully trained observers. At night, the wake may be detected by searchlight. A trained observer could probably determine where the torpedo would hit the ship within 50 feet along the ship's side. However, the observer can hardly find any comfort in this knowledge. It merely adds horror to the situation, to see the white finger of death and know where it will strike, unless some means is available for thwarting the torpedo.

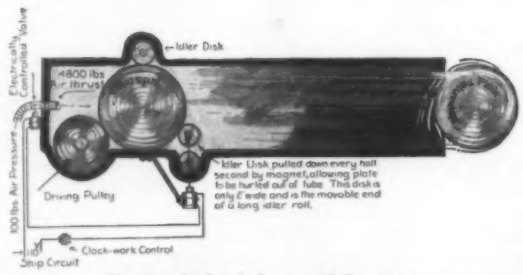
It has been proposed that shields or deflectors be placed in such a position as to explode the torpedo at a safe distance, say 20 feet from the vessel. It is an accepted fact that such a deflector must have no fixed connection with the ship. For instance, it has been found impracticable to use torpedo nets for ships under way at a speed of 20 knots, because the net could not be held under water; it would rise to the surface or be torn away by the water pressure. The use of a steel wall supported on pontoons and towed parallel to the ship's side is impracticable, except at very low speed, and the wall would be destroyed in the first rough sea.

The plan outlined below provides for building up a wall at the instant it is required, at a distance of 20 feet from the side of the vessel. The wall is made up of disks which are revolved at high speed, so that owing to gyroscopic action they will maintain their plane parallel or practically parallel to the ship's side and offer a maximum area to the attacking torpedo. The disks are built up of steel with an air space between them so that they will almost but not quite float. This will prevent them from sinking too rapidly, and will maintain them in the desired position for the requisite length of time.

The steel disks are two inches thick and 24 inches in diameter, weighing from 30 to 150 pounds each, according to their construction. One of them may be seen in the accompanying photograph. They are projected from a gun by means of air pressure and are given rotation by an electrical mechanism within the gun; preferably a battery of parallel guns is employed, as shown in the drawing, so that a wide area is covered. Each gun has a magazine containing 40 disks. The battery of guns is preferably placed at the bow of the vessel, and the entire battery may be swung on an axis that is practically horizontal so as to direct the stream of disks to any point desired. The moving of the gun is electrically operated under the control of a hand-wheel, so that the gunner may readily take aim. It will be understood that aiming such a gun is a simple matter. The gunner can gage his aim by noting where the disks strike. If, for instance, the torpedo were approaching a ship at 30 knots and the speed of the ship were 15 knots, the torpedo would be making 50 feet per second while the ship was advancing 25 feet per second. If the torpedo was discovered at a thousand feet from the ship, it would be due to strike in 20 seconds and if properly aimed would be approaching on a line 500 feet ahead of the center of the ship. The gunner would then have to aim at this point, which would be apparently coming back toward the ship at the rate of 25 feet per second. He would, therefore, have to swing his gun to keep it on that point. The whirling plates on striking the water would sink slowly to the ocean bottom. On account of their high speed of rotation (2000 rotations per minute) they would keep the same plane, cutting into the water like a knife and sinking slowly and vertically, as part of a wall of plates. The torpedo crashing into one of these whirling disks would explode at about 20 feet from the ship's side, and the water intervening between the disk and the ship would act as a cushion to prevent damage to the vessel.

One of the drawings shows a section through one of the battery of guns. Each gun has a rectangular barrel just wide enough to permit the passage of a single disk. All the disks in the magazine are rotated by frictional contact with a driving pulley, which in turn is rotated by an electric motor. The disks are maintained within the magazine by means of rollers which keep them out of contact with the casing of the gun The barrel of the gun is at the upper end of the magazine, and toward this end the disks are fed by air pressure. Directly in front

(*Concluded on page* 421)



Sectional view of one of the guns

One of the disks used for protection against torpedo attack

The Fangs of a Bombarding Warplane

JUDGING from the reports of successful aeroplane raids on railroad centers, industrial works, towns, and military points, it is quite logical to surmise that the aeroplanes of the fighting nations of Europe are fitted with elaborate bomb-dropping devices. Certainly they must be using something better than the hand-dropped bombs which were employed during the early months of the conflict. And in this connection the accompanying illustrations tend to throw some light on the type of apparatus employed on the huge bombarding warplanes of the Western Allies.

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A Maurice Farman bombarding-plane equipped with a Lewis machine gun mounted on a circular framework first introduced by the Germans

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The bomb chute of a bombarding-plane with a bomb at the moment of discharge

The first of these illustrations depicts the nacelle of a Maurice Farman bombarding warplane, carrying a pilot and a *tireur* or gunner. The latter, it will be noted, stands within a circular framework which mounts the Lewis machine gun in such a manner that the latter may be carried around to bear on any point of the compass. The Germans are given full credit for the invention of this practical form of gun mounting, which has only of late been adopted by the Allies. On the underside of the nacelle, well towards the front, there appears the end of a chute through which the bombs of the warplane are discharged, while in the second illustration the chute is shown at the moment a bomb is being ejected.

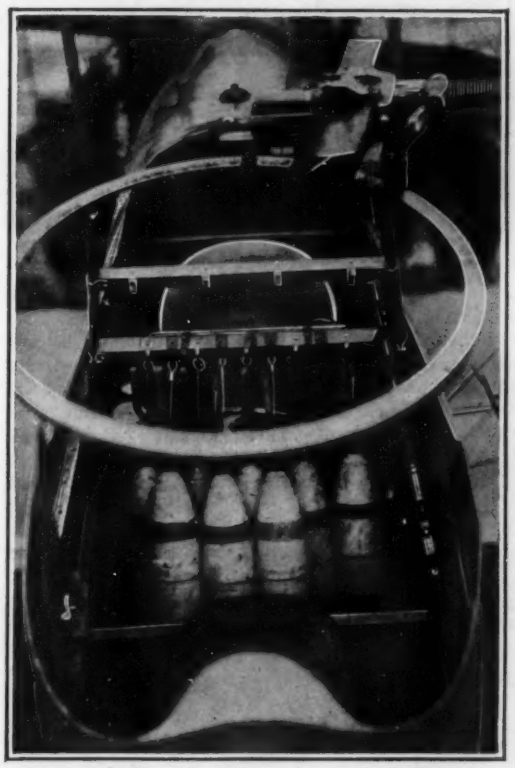
It is the duty of the *tireur* of a bombarding-plane not only to drop bombs on the objective of the expedition, but to man the machine gun in the event of the slow bombarding-plane being attacked by the swifter fighting-planes of the enemy. Usually the bombarding-planes are accompanied on their journey by several fighting planes, whose duty it is to circle about the slower machines and defend them against hostile fighting-planes; although occasionally the heavier members of the fleet must defend themselves. The third view clearly shows the weapons with which the *tireur* carries on his work of destruction. The circular framework mounting and Benet-Mercie machine gun appear in the upper part of the illustration, while below them are eight aerial bombs ready to be hurled to earth, one by one, at the option of the operator sitting in the seat seen in the foreground. The bombs, which actually consist of artillery shells of about six-inch caliber with the gas bands removed, fitted with a torpedo-like tail, are released by pulling the levers in back and slightly above them. Ordinarily the contact detonating fuses of the shells are "dead," but connected to their mechanism is a wire leading to one of the crosspieces below the machine gun. The moment a bomb or shell is released, its wire, remaining in place, causes the fuse to become "alive" and detonate the charge upon contact. The bomb actually comes out of the chute tail foremost, but soon rights itself because of the massing of weight in the shell portion and the guiding fins of the tail. From a close study of the photograph it appears that the bombs are held in a form of metal container, which probably narrows down to the chute much in the same manner as a funnel.

It is of interest to note that this particular bombarding-plane carries a service rifle, presumably for the purpose of defending the machine and its occupants should they be forced to land in back of the enemy's lines.

While no sighting apparatus is shown in the illustration, it is quite probable that some form or another of spotting device is employed; in fact, the flaglike instrument which appears at the right of the photograph, next to the circular framework, appears to be a drift indicator, which perhaps is part of the aiming system.

Introducing the Triplane Among Made-in-America Aircraft

FOR some reason or another the triplane type of aeroplane has never been popular among aviators, especially in America. In the pioneer days of heavier-than-air flight the triplane type was held in favor by several constructors, but soon gave way to the simpler monoplane and biplane designs. So the successful trials of a triplane recently designed and constructed under the direction of Glenn H. Curtiss, of Buffalo, N. Y., are indeed of interest and moment in American aviation.



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In the cockpit of a bombarding warplane, showing the bomb-dropping apparatus and the machine gun mounting

The new triplane has a wing spread of 25 feet, a length of 18 feet, a cord of 24 inches, and a gap of 28 inches between planes. Its gross weight, including fuel and water, is 1,060 pounds. The power plant consists of a 100-horsepower eight-cylinder V-type engine, driving a tractor screw.

A study of the accompanying illustration discloses the fact that every effort has been exerted to reduce the head resistance of the machine, among the most conspicuous features in this connection being the streamline wiring, the streamline shock absorbers and wheels, the streamline struts, and the reduction of all exposed parts to a minimum. It is also to be noted that the machine is of sturdy construction.

The triplane is said to have a climbing speed of 10,000 feet in ten minutes, and a speed range of 45 to 120 miles per hour. It is particularly adapted to speed scout duty in military aviation.

Speed scout triplane designed by Glenn H. Curtiss and recently tested with highly satisfactory results. It has a speed range of 45-120 miles per hour, and climbs 1,000 feet per minute

The Successful Breeding of Fresh-water Mussels

THE first successful attempt to secure the breeding of mussels under control has been reported from the Fairport, Iowa, station of the United States Bureau of Fisheries. This has been accomplished after many trials had been made by various methods. During August, 1916, eggs were produced and larval mussels or glochidia obtained from Lake Pepin muckets (*Lampsilis luteola*) held in a floating crate. Glochidia were taken from the gravid mussels and an implantation upon fish was obtained. These passed through the metamorphosis in less than 20 days and developed into juvenile mussels. As the parent mussels were reared from artificially infected fish, these juvenile mussels represent the second generation reared in captivity.

Anchor Your Farm by Blowing it Up

THE Federal Geological Survey is authority for the statement that an average of 95 tons of soil and loose rock are washed into the ocean every year from every square mile of territory in the United States. The stupendous amount of land washed away may be realized when it is taken into consideration that there are over 3,000,000 square miles of land in this country. This loss to the American farmer is gigantic, as it is obvious that the soil carried away is top soil—the richest in plant food and humus.

Is the best part of your farm being gradually washed away year by year? Do you allow the washes to develop into gullies to facilitate further the robbing of your soil? Have you failed to realize that the muddy creek flowing through your section is carrying a part of yours and your neighbor's farm away?

The question of checking this flow of farm land to the ocean is one that should be uppermost with every farmer. This loss cannot be stopped abruptly, but if every one would put his shoulder to the wheel and do his part, the great movement of farm land oceanward would, in a large measure, cease.

One of the best ways to permanently "anchor" your farm and stop the washing away of your land is by the use of dynamite. The idea is to deepen the soil reservoir and also to provide vertical drainage so that the water instead of "running off" will "run in." This is easily accomplished by blasting the subsoil.

In blasting the subsoil the hardpans are shattered, the subsoil is opened up to a depth of several feet, and the impervious subsoil broken, providing adequate drainage. By this means the water, instead of running off and carrying the farm with it, is held in the soil and conserved for the farmer's future use.

Strategic Moves of the War, October 26th, 1916

By Our Military Expert

THE writer regrets exceedingly to be thought stubborn, as many have doubtless concluded, but, apropos of the existing situation in the Dobrudja, he feels impelled to stick to his guns and the principles set forth in an article some weeks ago anent the geographical formation of the Dobrudja province and the danger attending a Teutonic force which might be pushed too far to the northward. It was stated then that for all practical military purposes and values, the Dobrudja need not exist, as it lies entirely without Roumania's line of defense, the Danube. Sizing up last minute reports, which since have turned out to have been erroneous, it was suggested at the time that a strong Entente movement had been launched across the Danube well to the rear of Mackensen's line of attack; instead, it now appears to have been but a reconnoissance which was speedily withdrawn in the face of superior force. But the situation and its possibilities are not altered in the least; the danger to Teutonia and the opportunity for the Entente still exist, clearly demonstrated by an inspection of the map of the section.

It is all nonsense for certain flamboyant journals to preach calamity because the Teutons have won the railway from Constanza to the Danube; and it is worse for them to proclaim that Roumania's sole avenue of supply is thereby severed; the railway in question undoubtedly was of service to Roumania, but a short seventy-five miles to the northward a good railway runs from Bessarabia into the heart of Roumania, and it is securely on the safe side of the broad Danube, and cannot be even troubled unless the river is forced—a monumental task—and the contiguous territory occupied in force to a considerable distance.

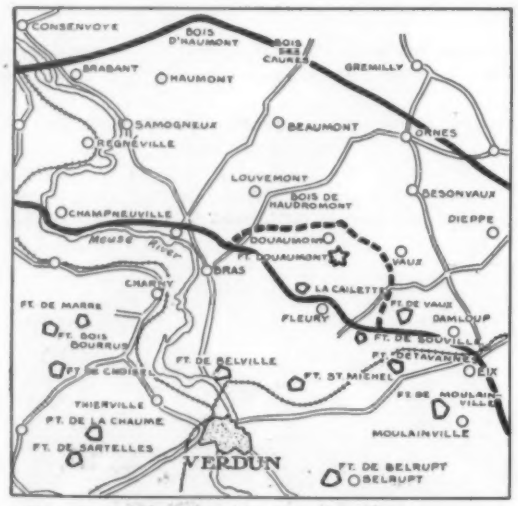
Look at the plan of the Dobrudja; see how the Danube bars it completely from Old Roumania in prehensile guard; except for the avenue of approach from the south, from Bulgaria, this province is practically an island, and its possession by Teutonia means almost nothing, merely the occupation of some handicapping territory.

Then look at the exposed flank and rear. While a German crossing of the Danube would be but a beginning of Mackensen's task, it is clear that the long narrow bottle neck of the Dobrudja would make, of a successful crossing of the Danube by the Entente anywhere east of Rustchuk, an immediate menace which it would be suicidal for Germany and her allies to ignore. The German staff cannot be considered for a moment as "going it blind" in ordering the invasion; probably there is some great factor existent of which there is no knowledge in this country as yet—as for instance, overly slow mobilization of the Roumanian forces—and perhaps the opportunity will present itself whereby Teutonia may even force the Danube and place mailed foot securely upon Roumanian soil proper. But this does not alter in the least the contention that, given combined action on other fronts and the gathering of a sufficient body of Roumanian troops to force the Danube east of Rustchuk, the chances for safety of the Teutonic troops now victorious in Dobrudja will not be such as to tempt underwriting by Lloyd's at any reasonable figure.

Germany seems to be taking a desperate chance. As stated before, the kaisers right now have all the men they can use on the line—and very few in general reserve. Everybody knows that in men and guns, the Entente now hopelessly outnumbers its opponents and surely this alliance is not going to ignore its duties. The Central empires seem devoted to the "nutcracker" tactics which so signally failed at Verdun. Mackensen is getting in position to the eastward—with the Danube to force first of all; Falkenhayn is storming at the Roumanian-Transylvanian frontier; a successful meeting of the two plier jaws would undoubtedly clip the lower and major portion of Roumania from the map of the Entente. But the Danube is yet to be forced—and the Russian Bear to the northward becomes more of a menace day by day the deeper Falkenhayn may penetrate.

There is such a thing as moral victory producing greater results than a large local tactical success. Consider Verdun. For weeks the Germans hammered at the defenses of that town and hurled precious divisions with unstinted hand in fruitless assault after assault. At the time, to every military critic in the world it seemed like a sheer and unwarranted waste of life, utterly disproportionate to the possible benefits to be gained by capturing Verdun. A little unwanted territory was lost by France—unwanted in a military and topographical sense—but the defenses held, and France won her tactical victory. But the moral victory came gradually to be recognized; it was a test of strength for France and Germany and France took such heart from the dawning conviction of the outcome that all the land, and the lands of her allies, were inspired and uplifted with the great sense of victory and security.

Now comes an aftermath. The battle of the Somme broke in fury while the Crown Prince yet made pretense of sustaining the attack upon Verdun. Russia awoke in the east and tore a gap in the Austrian defenses which strained every resource of Teutonia to



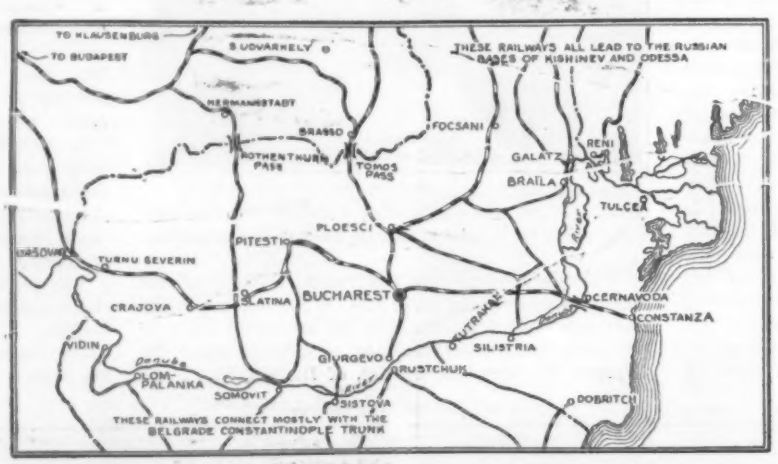
Map of Verdun showing with broken line the recent French advance

repair; Italy swept into Gorizia and Roumania came into the fight; the lines were extended. There remained but one resource and Germany depleted her lines in France other than to the northward, to bolster up the Somme defenses and meet emergencies arising elsewhere. Carefully calculating the time, the French High Command, through General Nivelle, stormed out of the battered Verdun trenchments and with losses only slightly in excess of the prisoners taken, occupied important points which have been fought over for months, and gained a depth of two miles on a four mile front, upsetting in a day of accomplishment the work of endeavor to which Germany had devoted at least three months. Fort Douaumont, Caillette wood, Furmin wood, Vaux de Chapitre wood, Chenoise-Laufee wood and the scarred Damloup battery have come again completely into French hands and such is the position that Fort Vaux is threatened with immediate capture in addition. Verdun stands for so large a principle, so many men have died on each side in its testing, that the recent brilliant sortie is so much greater to France, if only morally, than the winning of all useless Dobrudja would be to Germany. Verdun has been for months a veritable thorn in Germany's side, and this latest French achievement must make it fester sadly; for Germany, too, was fighting there for a great principle—dominance of *morale*—and she has lost.

The success of the Verdun thrust is significant. Germany is sadly weakened, it is most evident. A year ago the reserves would have been rushed to such a point by corps; to-day Germany would rather give way even at such a price than send in her general reserves prematurely, for there has been no truer axiom of war, an axiom proven again and again throughout history, than that the country without reserves, the country which has sent in her last, is even then defeated; and Germany is not yet willing to concede defeat, not though other millions must uselessly lose their lives for a Lost Cause.

One last prediction. The writer has examined every tiny clipping, every press story, every official report which he has been able to get hold of; sheets of figures have been compiled and considered without jugglery, and the general conclusion was set forth in last week's issue. Germany and her allies have lost from military availability eight million men in round numbers, out of a potential strength of sixteen millions; eight million men are needed to man the various fronts; and the monthly loss is about four per cent of the whole. The Entente has lost as many as Teutonia—but out of a conservative potentiality of twenty-eight million. From about now onward, the balance must inevitably begin to sway to the final decision, regardless of local successes anywhere. The beginning of the end has come and arithmetic is not to be denied.

These are strong words, but they are not set forth in a spirit of personal bias nor through a wish to impose a personal opinion upon others; they come from the conclusions of attempted analysis and a deep sense of conviction that the law of attrition cannot be gainsaid; the end seems inevitable.



Map of Roumania showing the relation of Bucharest to Constanza

The Telethermometer for Aeroplanes

ON aeroplanes employing water-cooled motors it is frequently of vital importance to the pilot to know the temperature of the water. A rise of temperature for instance may indicate loss of the cooling fluid due to lack of water-tightness. Moreover the proper functioning of the motor is dependent on the correct temperature being maintained. Thus one concern advises customers that the best temperature of the water for its motors is 75 deg. Cent. at the point of egress from the cylinders. Since many accidents can be foreseen and prevented if the pilot has immediate knowledge of any change of temperature in the circulating water, it is advisable that this knowledge should be attainable at a glance, without the necessity of his turning around. The ordinary thermometer is not adapted to the purpose, therefore, and the German aeroplanes make use of an adaptation of the electric telethermometer.

This consists, first, of a metal part immersed in the liquid, and containing a spiral to record the temperature; and, second, a galvanometric indicator placed near the pilot's seat, the two being connected by a conducting cable. The scale of the galvanometer is clearly visible to the pilot.

No manipulation of the apparatus is required and it is not affected by vibration or shock.

The source of the current is a small accumulator or a dry battery with interrupter. The thermometer proper consists of a spiral of platinum wire in a metallic armature. The indicator apparatus is based on the principle of the ohmmeter.

This apparatus is of special importance when the aeroplane is provided with two motors, since in such case it is obviously impossible for the pilot to detect irregularities of action either by ear or by eye. Though the French do not employ the water-cooled motor so frequently as do the Germans, they have promptly perceived the value of this device and will doubtless make use of it whenever desirable.

Teaching Surgery with the Aid of Motion Pictures

FOR the first time, so it is claimed, motion pictures were recently applied as an aid to the most difficult operations in surgery. The occasion was when Dr. S. William Schapira, member of the Academy of Medicine, lectured at Fordham University on various genito-urinary operations, illustrating his lecture with motion pictures of actual operations performed by him. These pictures, which possess an extraordinary scientific value, cover thirteen distinct operations, and were made by a Pathé cameraman under Dr. Schapira's direction. In the past surgical lectures have been illustrated by "still" pictures or drawings, and much of the detail has been lost. In the present motion pictures, every movement is clearly shown; and it is perhaps not too much to say that a new era has dawned in the teaching of surgery.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Questions of Warship Design

To the Editor of the SCIENTIFIC AMERICAN:

I notice in your correspondence column an article from W. F. Johnston, viz., Battle Cruisers vs. Battleships, etc., in which he does not think the building of battle cruisers justifiable. I have also read with interest Admiral Knight's report on the same and entirely endorse, so far as my knowledge goes, coupled with the trend of events, everything that he (the Admiral) says; and if anyone cares to go into the matter and note carefully the naval policy of two powers at least, leaving Great Britain out of the count, I think it must be plain that it is necessary for the United States to possess such vessels in the Navy. The battle cruiser has nobly upheld everything that was expected of it and something over. After all it bears the same relation to the modern battleship that the heavy armored cruiser did to the pre-dreadnought battleship.

As regards scouts, Mr. Johnston says, build scouts of about 7,000 tons 35 knots and arm them with six 10-inch guns and they would do for everything that a scout and a battlecruiser would do. In the new scouts proposed to be built, I see the displacement is about 7,000 tons 35 knots speed, armament eight 6-inch guns and about two 3-inch anti-air guns, hull about 550 feet long. Now as the hull will in all probability be sheathed to a great extent with armor somewhere about 3 or 4 inches thick and oil fuel used, very powerful engines and large boiler plant, I take it that eight 6-inch guns well placed, will be a good armament. Now, in view of the four great essentials in warship construction, viz., speed, radius of action or fuel endurance, gun power, and defensive armor, as large a proportion of each as can be possibly put in has been figured on; and, in further view of the fact you cannot put a quart of water in a pint measure, I have been wondering how six 10-inch guns could be crammed in the ship of Mr. Johnston. The 50-caliber, 6-inch gun, Mark VI, weighs eight tons, six hundredweight; the 50-caliber, 6-inch Mark VIII, weighs eight tons twelve hundredweight; a 50-caliber, 10-inch gun weighs, according to the Bethlehem Ordnance Company table, 43.9 tons. In view of the fact that displacement is limited to 7,000 and a speed of 35 knots is maintained, the most that can be put in the ship is eight 6-inch guns. Now a ship carrying six 10-inch guns, to stand the simultaneous discharge, would have to be constructed with heavier scantling, etc., than for 6-inch guns. Looking at it from every standpoint, I am sure that Mr. Johnston would find, when he had his ship built, that something would have to be left out that would conflict with the four great qualities; or, to sum up, as I said before, he would find that a quart of water will not go in a pint measure.

W. R. SHEETE.

21 Gloucester St., Toronto.

To Owners of Small Telescopes

To the Editor of the SCIENTIFIC AMERICAN:

The American Association of Variable Star Observers has just completed its fifth year of work observing variable stars, with a total to date of 59,500 observations.

More recruits are needed for the work, which involves no mathematics, and the details of which are easily mastered. All that is required is a star atlas and a telescope of three-inch aperture or larger. The undersigned will be glad to furnish information regarding the details of observing, and pleased to assist any one who is willing to coöperate with us.

Here is a chance to do some telescopic work that is really worth while, of fascinating interest and scientific value. No obligation is imposed on members of the Association save a willingness to observe variable stars when it is convenient.

WILLIAM TYLER OLCOTT,
Corresponding Secretary.

Norwich, Conn.

More About that Egg

To the Editor of the SCIENTIFIC AMERICAN:

Under "Correspondence" in the SCIENTIFIC AMERICAN for October 7, is an interesting article on "The Strength of Eggshells," by G. Herrasti, in which is made this statement: "The fact that no man, no matter how strong he may be, is able to break a sound hen's egg, by squeezing it between his hands, applying the pressure according to the axis of the egg," etc.

I can sympathize with Mr. G. Herrasti most heartily because I used to believe this, but I must (without meaning any offence) differ with him just the same.

The first time I saw an egg burst I was unable to believe it was fairly done. I convinced myself by doing it myself. I was so astonished I tried to find out why I had failed before, and realized that I had never really tried. I believe those who fail don't try.

The reasons for this come under four heads: (1) An acquired habit of handling eggs with great care. (2) Simple dread of getting spattered. (3) An instinctive fear of anything breaking in the hands. (4) Two or three half-hearted efforts bruise the hands so that further real effort is almost impossible.

I am 25 years old, about 5 ft. 7 in. tall and weigh 145 lbs. I am not considered stronger than the average, yet I can break any normal hen's egg. I can break most of them with one hand. New laid eggs (less than a day old, with little or no air space), are very hard to break. Long, narrow eggs are strong and hurt the hands.

If G. Herrasti will pick an easy egg, a short round one or an ordinary egg with a large air space, and place his hands between his knees and help with his legs, then remember to make a supreme effort the first time, he will astonish himself by breaking the egg.

Yours truly,

LELAND H. MILLER.

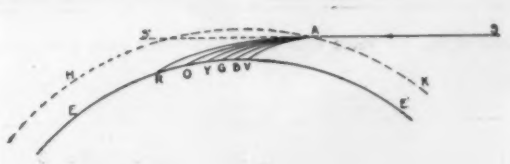
Enid, Oklahoma.

A Phenomenon of Optics

To the Editor of the SCIENTIFIC AMERICAN:

The accepted theory regarding the colors appearing in the sky at sunset has always been that the shorter wave lengths, including the green and violet end of the solar spectrum, were screened out by the selective action of the atmosphere. The sunlight being forced to pass through a greater thickness of air at sunset than at any other time of day has always accounted for all the color effects observed during sunset.

While not antagonistic to this established and accepted theory of color at sunset there should be another and more important effect present which would tend to enhance the customary observed phenomena and explain fully some secondary effects often seen at sunset. This effect is dispersion. When a ray of sunlight S A strikes the outer limits of the atmosphere (H K) the ray will be refracted and dispersed or spread out into the colors of the solar spectrum. Thus during the sunset period under very favorable conditions it is possible to observe faint tints of violet, blue, green and then, gradually strengthening, the yellows and reds. This would be the effect expected on the dispersion theory. As the earth's atmosphere became progressively denser the refraction and dispersion would become more marked. The reason the blues, greens and violets are rarely noted is readily explained by the presence of rather intense white light when these colors would be present according to the theory. As the white light faded and disappeared at the close of the sunset period, the yellows and reds might be expected to show up with their customary intensity.



On clear nights, when absorption is at a minimum, the reds and yellows are sharp and clearly defined, and under the proper conditions the other colors may be seen by close observation. On smoky evenings the yellows and reds are present alone, oftentimes accompanied by browns.

W. D. YOUNG.

Everett, Wash.

More Light on the Aurora

To the Editor of the SCIENTIFIC AMERICAN:

As I keep a careful record of all auroras seen here, I was much interested to read in the September 30th issue, SCIENTIFIC AMERICAN, a letter written by W. Eager on a peculiar light seen by him on the evening of July 19th, for on looking over my records I find that the same or a similar light was observed here on that night in question, but instead of it appearing in the north sky it was, roughly estimating, occupying a position as a narrow band of light about 10 deg. south of the zenith and extending in a northwest-southeast direction.

When I first saw it I thought it was the tail of some huge comet that had come upon us unheralded as they do sometimes, but after a few minutes study I could readily see that it was a detached band of auroral light. A few evenings later the same phenomena was observed again only not so well defined.

It is very evident that Prof. Carl Störmer's calculations of auroral activity are being verified as per his letter to me some time ago, for in this latitude the auroras have been very frequent of late and have been of the active variety or those of rapidly changing formation showing at times beautiful colors, especially that class known as "the drapery." The streamers show tremendous velocity of light and at intervals glow with an intense greenish light only to die out in a minute or so and rekindle elsewhere. Several of these auroras have been right in the zenith, but the majority of them seem to take place between 20 deg. to 65 deg. above the northern horizon.

They seem to be quite close to the earth but *this is probably an illusion* for when clouds are present during such displays, namely the cirrus, the highest of all clouds, floating at an altitude of about 10 miles above the earth's surface, they *appear far below the* seat of auroral illumination.

It would be well for those interested in such matters to watch the northern skies these evenings.

DOUGLAS F. MANNING.

Alexandria Bay, N. Y.

Galalith—A German Insulating Material Obtained from Skimmed Milk

UNDER the name "galalith," a bonelike substance similar in many respects to celluloid has been on the German market for some time. Its production is protected in Germany by several patents issued at various times and bearing in the Imperial Patent Register Nos. 115681, 127942, 141309, and 147994. It has not yet reached an importance that warrants its mention in the German official statistics, but that the production is increasing is shown by the exports to the United States alone, which have increased from year to year. In the past four years, they were: 1912, $10,769; 1913, $12,007; 1914, $16,395; 1915 (first six months), $6,274.

Galalith is manufactured from casein by means of formaldehyde. A solution of casein is obtained by treating skimmed milk with caustic alkali or carbonate of alkali. This solution is clarified and the casein precipitated by means of acids and then filtered. The water is then partly extracted by pressure and the product dried very slowly. The drying process extends over a period of several weeks. The casein plates thus obtained are thoroughly saturated with formaldehyde and dried again. The product obtained is somewhat transparent, of a yellowish-white color, and very similar to horn.

If a colored or mottled product is desired, coloring matter is added to the solution of casein, or powdered cork, soot, wood pulp, earth, etc., are kneaded into the precipitated casein. Acetate of lead is also used in the precipitating process. The specific weight of galalith is 1.317 to 1.35; the hardness is 2.5, according to the Mohs scale.

Galalith is an excellent insulating material, and may be utilized either in a cold state or after it has been softened by using hot water. It is free from odor and is not so inflammable as celluloid, but is never entirely transparent, and it is not possible to manufacture it in very thin sheets.

Farming for Weeds

WITHOUT a doubt Prof. W. L. Oswald, of the University of Minnesota, has one of the most extensive wild oats crops in the country. For several seasons he has been cultivating this weed in its various forms on the university farm in order to learn some of the secrets which some day will permit its extinction from the farms of the country. These experiments are being conducted on one of the most unique farms in the world, given over entirely to the growing of weeds and other plant pests which make trouble for the farmer who is bent on growing other crops than wild oats. On this small farm the students are being taught how to distinguish and eradicate the different weeds.

Prof. Oswald is familiarizing his students with the more than 240 varieties of weeds which have invaded Minnesota. At test time students are given bottles containing 168 varieties of weed seed and are required to name every variety. When they return home the pests on their fathers' farms are classified instantly and the hired hand is told how to slaughter them. Each day the professor and members of his class visit the farm to weed out the clover, wheat and other domestic plants which have invaded the weed farm in order that the wild oats may be as perfect as is possible.

This season the farm contained 175 varieties of weeds which grew in sufficient quantity to ruin half a dozen prize farms. Each weed has its individual plot which is fenced off to prevent encroachments from other weeds. Because of the hot weather the quack grass did poorly this season, although farmers reported good yields of corn and small grain. However, Prof. Oswald's 1915 crop was sufficient to tide him over the emergency. Wild mustard never grew better nor has milkweed thrived more luxuriantly than it did this year. In fact, taking the season as a whole, the year 1916 will go down into agricultural history as an excellent one for all of nature's various forms of wild oats.

Letting the Eye Train the Voice

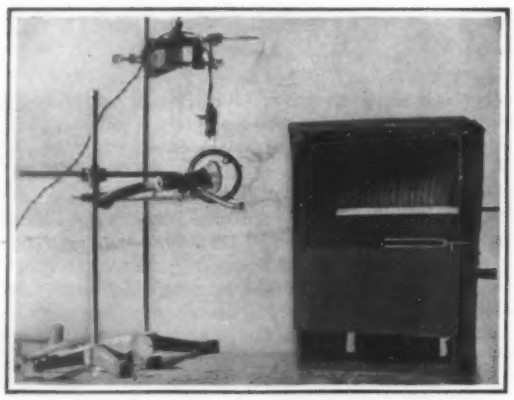
A New Instrument That Shows a Singer Whether He Is True to Pitch

By L. E. Dodd, M. S. Assistant in Physics, State University of Iowa

IN the interpretation of a song it is the function of the singer's spirit, as well as his intellect, to select (and this is not entirely a studied or self-conscious act) that combination, especially of quality and loudness, best suited to present a given emotional state to the listener. When this state is properly presented the listener himself "feels" with the singer, and the song is effective, in other words it is a real song. Also, the matter of pitch, by virtue of its artistic variation, contributes to the effectiveness of the song. Pitch variation has been previously determined for the singer by the composer, so that he is not so free to introduce his own personality into the song in this respect. But the matter of fidelity to pitch as it has been laid down in the writing of the song is of primary importance. It is the *sine qua non* of good singing. Musical intervals to be pleasing must be true pitch intervals. Up to the present time the chief test for trueness to pitch has been the human ear. The ability of precise pitch discrimination, however, has been cultivated only to a limited degree with most people, and even trained singers have their limitations.

It is indeed true that an individual with a good musical ear can discriminate with a certain degree of precision between tuning forks differing in pitch by as small an amount as a single vibration per second and sounded in sequence, where the individual judges whether the second fork is higher or lower in pitch than the first. But it is more difficult for a singer to govern the pitch of tones sounded by himself than it is for a listener of equal musical ability to detect errors in pitch of tones under the conditions just stated. Judgment of pitch of tones sounded by agents not the singer's own voice, such as tuning forks, is a far easier matter for the singer than it is for him to make a pitch variation in his own tones of one, two, or three vibrations per second, or, having sounded a certain tone, to skip a relatively large pitch interval, a third or a fifth, and land on the correct number of vibrations per second after having made the leap. The half-tone interval, even though the smallest of the intervals in the musical scale, offers difficulty. The ability on the part of the singer to govern pitch in his own tones varies greatly with the individual, and also in the same individual depending on his physical condition. From the standpoint of the singer, whether beginner or professional, and especially at times when his power to control the pitch of his own tones is below normal, a mechanical device that will tell him instantly the absolute pitch (number of vibrations per second) of his tones will make unnecessary the presence of a second person with good ear as judge, and will itself give absolutely reliable judgment.

A singer trying his voice with an experimental form of "tonodeik"



The "tonodeik" in an early stage of development

Final form of instrument for indicating true pitch

Up to the present, no such instrument as an absolute pitch indicator has come into any degree of general use, although means of mechanically indicating absolute pitch have been known for some time. The chief reason for this has been the slow development of an instrument of sufficient compactness, accuracy, inexpensiveness, and ease of operation to make it readily accessible to the public. The few voice pitch indicators in use are laboratory instruments employed in the interests of science.

Instruments for testing pitch are of two general types; recording and indicating. By photography or tracings the former type records the sound waves for later study. This type requires much time and labor for a series of readings at all complete, and for this reason is not nearly so desirable as the second type.

For a long time it has been known that the absolute pitch of a tone can be instantly made manifest by a common physical phenomenon, that of stroboscopy. Of these the Forchhammer phonoscope is probably the prototype, follwed by the Scripture disk, and then by the Seashore tonoscope. This last instrument has marked until recently the farthest advance.

An explanation of stroboscopy may not be amiss. The phenomenon is commonly seen on a motion picture screen when the wheels of moving vehicles appear to be revolving in the wrong direction. The wheels will sometimes lessen their backward motion and then although the driver may be driving at a lively pace, will seem to stand absolutely still. A little later the same wheel may take on a slow forward motion, which will increase until the whole wheel is nothing but a blur. This result is due to the fact that motion pictures are made up of a series of snap shots each representing the object as standing still. If picture No. 1 shows a wheel with a spoke in vertical position, and picture No. 2 is taken when the next spoke reaches the same vertical position, the wheel will apparently be standing still during the interval. If the pictures are taken at such a rate, spoke No. 2 does not quite reach the vertical position when the second picture is taken and there will be an apparent backward motion; whereas, if the wheel is traveling a little faster and spoke No. 2 is moved beyond the vertical position, the wheel will seem to have turned slowly forward. It is this principle that is used in the Seashore tonoscope to indicate the pitch of the voice.

An article describing the instrument appeared in the SCIENTIFIC AMERICAN of May 13th, 1916. It will be recalled that the instrument consists of a hollow drum in which are series of perforations arranged in rows running around the circumference of the drum. The interval between the perforations is different for each row. The drum is periodically illuminated by flashes of light from a manometric flame. This flame is made to vibrate in accordance with the vibrations of the voice of the singer; at the same time, the drum is revolved at a fixed rate. Owing to stroboscopic effect the rows of perforations will appear to be moving with various velocities, most of them showing as blurred lines. One row, however, in which the interval between perforations bears a proper relation to the period of vibrations of the manometric flame, will appear to be stationary.

Each row of perforations is marked by means of a scale to correspond to a certain pitch. Now if the singer succeeds in making that particular row corresponding to say, "G," stand still when he tries to sing "G," he will know that his voice is true. If he is singing slightly sharp or flat, row "G" will move and another row to the right or left of "G" will stand still.

It is only necessary to provide for a single octave because the dots will appear to stand still no matter in which octave the note is sung. The stroboscopic effect is the same whether the third or fourth perforation occupies the position of the first perforation at the second flash of light.

The range of dot frequencies of the 1902 model tonoscope was 73 to 146, and the frequencies advanced from left to right, as in the piano keyboard. The frequency of any tone actually sung, if it does not lie in this range, will be indicated by multiple effect. Thus tone frequencies 146, 292, etc., as well as 73, cause row 73 to stand still, and similarly with the other rows. The range of dot frequencies now used in the tonoscope is 110 to 219, requiring 109 separate rows in all.

An innovation introduced in the tonoscope for the purpose of reducing the necessary length of drum was to split the octave of rows into halves. The rows for the first half-range (110-164) were then equally spaced along the drum, and the rows for the second half-range (165-219) were alternated with these. Any two rows with a frequency difference of unity have a row between them whose frequency is removed from them by one half octave. Thus, any single row has on either side of it a row one half octave removed. If then a region responds stroboscopically to include, as it will, a number of rows, any single row that is responding in this region will have on either side of it a row that does not respond because of its widely different frequency but appears as a blurred gray streak. Such a row in response is thus "framed" by two rows not responding, and the effect has been called the "framing effect." The rows of dots not responding might as well be replaced for the time being by drum wall, so that the practical result of the splitting up of the octave is to double the distance between rows of successive frequencies with no change in the drum length.

By the use of the tonoscope in his laboratory during the last 10 or 15 years Prof. Seashore has gathered a considerable amount of data from voice pitch tests. There have been available for these tests students of the university as well as residents of Iowa City. From the data some conclusions have already been drawn. A few of these are:

High tones are sung relatively more exactly than low tones. The voice can most easily reproduce pitch

(*Continued on page 422*)

Photography With a Horse-Shoe Magnet

Some Peculiar Results Obtained by Exposing a Photographic Plate to a Magnetic Field

By F. F. Mace

THE photograph reproduced in Fig. 2 herewith is a positive printed from a negative which was made solely by the action of a common permanent "U" magnet weighing one kilogram. In the photograph "A" is a lead ring or washer, "B" a pearl button, "C" a piece of partially acid eaten zinc, "D" a broken tin buckle, "E" a wooden button, "F" and "F" iron weights, "G" a piece of sealing wax, and "H" a piece of resin. In Fig. 3, which is an ordinary photograph, the same letters indicate the same objects. The piece "K" is a piece of gasket rubber which was lost before the photograph was taken and therefore does not appear in Fig. 3.

The writer has done photographic work in connection with other matters for 15 years and knows how to handle photographic processes and knows the precautions necessary in this line. The plates obtained are not the results of accident, ignorance, or oversight.

Fig. 1 shows how these objects were placed on a photographic plate, sensitive side upward, under the exhausted receiver of an air pump. This exhausted receiver, it may be said in passing, is not necessary to the production of the magneto-graph, but was used in this case for a certain specific and definite purpose, which purpose will be developed later. All of the work was done in a dark room, the only light used being a dim photographer's red light which would not affect the photographic plate. Under these conditions an unexposed photographic plate was placed over the U magnet, as shown. On this plate were placed the objects shown. The receiver was then set over them and over the receiver was placed a hood composed of 12 thicknesses of black cloth so as to exclude every particle of light. The air was then exhausted from the receiver. To make it doubly sure that the plate could not be effected by outside light, another unexposed plate was then put in an open carrier outside of the hood and over all of this was placed a light tight box which in turn was wrapped with ten thicknesses of black cloth. The red light was then taken from the room and the dark room containing the apparatus was closed and locked and was not reopened for 20 days. At the end of that time the two plates were taken out into the dark room and developed under the red light in the same manner as any photographic plate. The second plate, the one nearer any external light, showed no change in condition (was a blank plate) while the one over the magnet showed the condition reproduced in Fig. 2.

Even a very superficial comparison of the Figs. 2 and 3 will show that the former can not be produced by any photographic process using ordinary light. Some of these results can not be produced by light. Nor is it possible to "fake" a plate similar to this which will stand a test under the microscope. Moreover, anyone can verify the result by trying the experiments for himself.

Even if this experiment has done nothing more than to show that a permanent magnet has an effect upon a photographic plate—an effect corresponding to the action of the X-ray upon such a plate—it is of itself a significant and important contribution to science.

There are but four things which produce change in a photographic plate. Light, which is a form of motion; the X-ray, which is motion; chemical action, which is motion in the form of changing relations among the molecules; and heat, which is also a form of motion, in the later case the effect being merely a general change in the plate without the formation of a definite image. It is evident, then, that here, too, there must be some form of motion.

THE AUTHOR *of this article is Superintendent of Public Schools, in Pecos, Texas. His experiments are exceedingly interesting. It was at our suggestion that the experiment was performed with the wooden support in place of the magnet. While we are not prepared to accept Mr. Mace's theory, we have none of our own to offer. We should be glad to have others try the experiment and report their results.*—EDITOR.

Now examine the plate more carefully for further evidences of this motion. Note especially the difference in the intensity between "A" and "C," between "C" and "E," and between "E" and "H" or "G." In order to have produced this result one substance must have been penetrated more than the other. This implies motion—*motion*—and motion implies *currents*. The mere fact of the penetration of any substance would imply the same thing; motion and the existence of currents.

Fig. 1. Arrangement of apparatus for taking photographs with a magnet

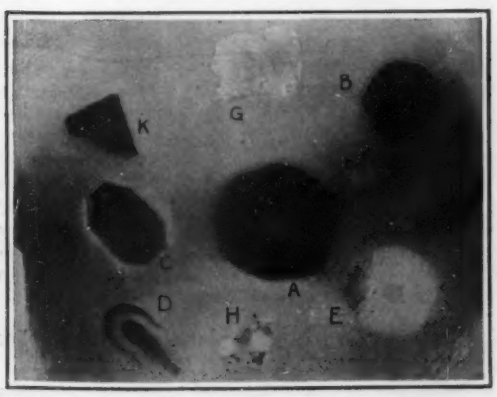


Fig. 2. Magneto-graph made in a vacuum

Fig. 3. Objects that were magneto-graphed

Observe "A" and "C." Not only is "C" penetrated more than "A" but the acid pits in "C" are penetrated more than the rest of the plate. Light could not have done this. Moreover, in order to produce this penetration there must have been motion—currents.

Note in "F" and "F" in figure No. 3 the cavities in the bottoms of the weights and the holes through the sides. In the magneto-graph these cavities are reproduced while the weights are sitting upon the ends containing them and are rendered in almost exactly the same tones as the surrounding plate. Light cannot have produced this effect. In order to produce this result a current must have entered the hole in the side and passed downward to the plate and this current must have been almost as strong as the external current. Furthermore, careful measurements will show that the disks as shown in Fig. 2 are a little smaller than the actual weights (which is not true of the other objects) and that the cavities are shown a little larger than they are in reality; so much so that in one the border of the cavity almost disappears. Therefore the currents must have followed down and under the sides of the iron, which is a well known effect of iron in a magnetic field.

In "E" *the grain of the wood is clearly shown.* This can not be a light effect, for light will not penetrate the grain of wood. Here currents have penetrated all of the wood, as clearly shown in Fig. 2, but the loose grain of the wood was penetrated more than the solid part, there was, therefore, a current which penetrated the loose grain readily, but which was partially stopped by the closer part of the wood.

Observe that the effects are equally strong and marked over *both* poles of the magnet. There are, then, equal currents entering both poles. A current does not pass from one pole to the other, for if it did so the object on top of one pole, where the current moved downward, would be impressed upon the plate while the object at the other pole, where the current would be moving upward through the plate and toward the object, would not be reproduced upon the plate.

As has been said, only some form of motion or chemical action will affect a photographic plate. Here there is no chemical action except the ordinary action of development and therefore there must have been motion. To say or to maintain that "lines of force," "lines of direction," or "lines of stress in ether" (I am quoting from present authorities) can affect a photographic plate so as to produce a magneto-graph or shadow-graph is to maintain a rank absurdity. There are, therefore, currents surrounding and entering *even a permanent magnet.* This cannot be disputed.

These results may be obtained by other methods than then herein explained. The writer has produced the same results in greater and in less time, the length of time merely giving greater or less density to the negative, has produced the results in air over a permanent magnet, has produced the results over an electro-magnet in much less time, and has produced similar results over a wire bearing a current, all of these showing the effect of a magnetic or electric field upon a photographic plate.

The writer has for more than 15 years studied magnetic and electric action and has experimented with these. This discovery is the culmination of his study and experiments.

As a further test the same objects were placed upon a wooden "U" shaped support under the receiver originally used, the air was exhausted, the receiver was carefully covered in exactly the same manner as in the original experiment, and the whole was locked into the same dark room formerly used and allowed to remain 22 days. No image of the objects placed upon it appeared.

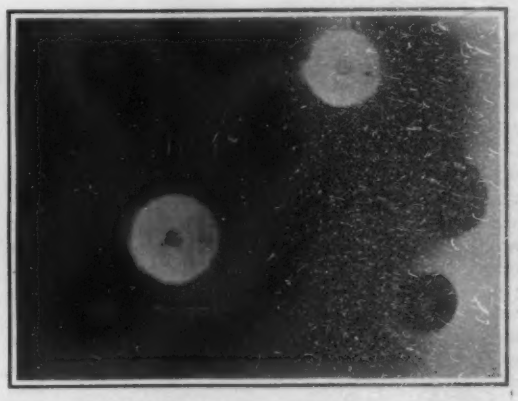


Fig. 4. Magneto-graph made under atmospheric pressure

Another plate placed in the same room at the same time with similar objects on the sensitive side and enclosed in an ordinary cigar box over which was thrown a few thicknesses of black cloth also developed nothing.

Fig. 4 is a plate exposed at the same time in the same room over the magnet used in the original experiment. In this case the magnet with the plate and objects (pearl buttons, wooden buttons, and a key)

(*Concluded on page 421*)

The War Aeroplane Here and Abroad

Where Does the United States Stand With Regard to the Eyes of the Army?

By Bertram Williams

PERHAPS of all Uncle Sam's infant industries, that which has made most strides since the great war is the manufacture of aircraft. Although aeroplanes have been made in this country for the last seven or eight years, it is only since the beginning of 1915 that their manufacture has become an organized industry employing hundreds of skilled workmen; one which, it is hoped, has come to stay. Previous to that time, with the exception of the Curtiss, Wright, and one or two other firms, there were no factories making a standardized type of aeroplane in this country. Nearly every American aviator made his own, and the result was a queer collection of freak machines, and a higher relative percentage of deaths through flying than that of any other country. Considering that the heavier-than-air machine originated here, it is strange that so little interest has been evoked in its development by the refusal of the average American to take up with anything that cannot be turned to immediate commercial use. A few foolhardy young men saw in the new "sport" a means to make big money by pandering to the taste of the crowd, which always and everywhere will pay to see a man risk his life. Or it may be because of that very word sport, aviation has not been taken seriously over here.

France, ever eager to be in the lead in mechanics, did not look upon the mastery of the air as a pastime. She, alone among the nations, saw the vast and far-reaching possibilities of aerial locomotion in war, and in peace also. The great French flyers of the early days were not—with the single exception of Latham—of the "idle-rich" class, but keen headed business men like Blériot and the Farmans, or poor mechanics like Vedrines and others. The French public took an intelligent interest in the practical side of aviation, the different types of machines, the possibilities of this or that motor-engine, in distance and altitude records, rather than in the hair-raising stunts which delight the American public. Had France gone to war five or six years ago, she would have had an immeasurable advantage over her adversaries, who would, when compared to her, have been fighting in the dark. There are wiseacres who say that this was the chief reason why Germany relinquished her Moroccan ambition a few years back.

A slow second, it was not until the middle of 1911 that Germany began to foresee the advantages of the new arm, and cautiously to study the heavier-than-air problem. Up to that time she had pinned her faith in the gas-filled dirigible first evolved by Count Zeppelin. By-the-way, it might be mentioned that not all the airships so glibly characterized by our press are Zeppelins. There are, or were, several other types of rigid and semi-rigid dirigibles in use by the government there. The same may be said of that over-worked word *taube* (dove). According to the average newspaper correspondent in England and elsewhere whose ignorance of aerial matters is appalling, all German aeroplanes are *taubes*. As a matter of fact the *taube* type, which is a monoplane with upturned wing-tips set at a negative angle to increase stability—and really more resembling a sea-gull than a pigeon when in flight—was practically obsolete before the war. The writer was present when Herr Etrich, the Austrian originator of this type, flew over to London from Germany in a two-seater of his own build, and was struck by the slowness and sluggishness of the machine when in the air. No doubt, there were several of the old-fashioned monoplanes used by the Germans at the beginning of the war for spotting artillery before the enemy brought up their fast "chasers" and scouts. From photographs smuggled out of Germany by an Englishman only a week before war was declared, the latest types of aircraft in that country were no secret to those connected with service matters in England. The great German aeroplane factory, the Deutsche Flugzeug Werke, had for some months previous been turning out fast biplanes for the British navy at a branch factory on English soil—surely a potent argument, one would think, against those who say Germany wanted war.

John Bull, cautious as usual, although he was quite aware of the military possibilities of the aeroplane, waited for some other and more enterprising nation to try the idea out. It was not until a few public-spirited aviator-inventors had almost ruined themselves that the War Office saw fit to encourage home industry. The British manufacturers have had a hard row to hoe, and if they are reaping the benefits now in heavy orders and good profits, it is no more than they deserve. Previous to 1912, nearly all the army machines in England were of French make. Then the War Office conceived a brilliant idea: why not start a factory of its own? Thus the R. A. F., or Royal Aircraft Factory, came into being. At first this was not the success its promoters had prophesied, although it provided a few sinecures for army favorites. Then some genius was struck with the happy thought of combining the tried and proven good points of several types, French and English, a wing here, a fuselage there, and so on, and putting them together. The result was a very fine machine which had all the military qualities of speed, quick climbing powers, and the ability to stand rough usage. This type known as the B. E. 2 (biplane experimental 2) has withstood the test of time; and with the exception of a few trifling alterations—which, by-the-way, cost the lives of several army officers to discover—remains the chief machine in use at present in the English army.

The Royal Naval Air Service, which is quite unrelated to the Royal Flying Corps, do not use the B. E. 2; will not, in fact, have anything to do with it, preferring types made by different English and French private firms. It may be news to the layman that the navy use quite a lot of land-machines as well as seaplanes.

England, unlike France, draws most of her aviators from the well-to-do upper and middle classes; officers from both services and young civilians attracted by the glamour of the air, who see possibilities of a career in either the R. F. C. or R. N. A. S. where the pay, though not high in commensuration with the risk, provides a living and prospects.

The real credit for aviation in Great Britain must, however, be given to the English press, and notably to the *Daily Mail* owned and directed by Lord Northcliffe. He alone among a notoriously conservative race of people saw the future of aerial navigation. By offering a prize of $5,000 for a flight of 25 miles across the English Channel, and another of $50,000 for a journey by air from London to Manchester, a distance of 200 miles, both of which were won by foreigners, he did much to dispel that mistrust which every Englishman entertains towards new ideas. Of course, there were those who saw in these handsome offers only a gigantic bluff, a novel means of advertising a daily paper. But was there ever a public-spirited campaigner who had not his cavilliers? Besides offering these, and other prizes, the *Daily Mail* did all it could to educate the public in aviation matters, this and that type of machine and engine, the need of public aerodomes, and, above all, set up a clamor in parliament demanding the use of aircraft in the army. For a long time the people were apathetic, and persisted in regarding aeroplanes and aero-motors as distinctly French creations. It is only within the last three years or so that many fast and efficient aeroplanes, designed and manufactured by English brains and hands, have come into being. For a while these machines were driven by French engines, chief of which was the famous, air-cooled, revolving Gnôme, a motor which has had more to do with the conquest of the air than any other invention. Recent advices show that the English are turning out their own engines, notably the Green and the Sunbeam—the latter manufactured by the noted automobile firm of that name, although designed by a Frenchman.

As, has been remarked above, the death-rate among aviators in the United States has been higher in proportion than in any other country. Not that Americans are less skilful than those of other nationalities, or that the air-currents or conditions of flying are more difficult here; indeed, the latter are on the whole better than in Europe. But most of the machines upon which fatal accidents occurred were mechanically imperfect. In many cases they were crude imitations of foreign makes with little or none of that "factor of safety" which European manufacturers put into their machines. Aeroplane making is no rule-of-thumb work. It is a mechanical science calling for a thorough knowledge of mathematics relating to wing-stress and dihedral angles and other such niceties.

With one exception, even among standard makes the United States has evolved no single original type of aeroplane that stands out alone. The exception is the well-known Curtiss flying boat, a machine which had already been adopted by several foreign governments before the war, and which served our navy very well down at Vera Cruz not long ago. Had Congress been as eager for preparedness a few years back as it appears to be now, we should occupy the same place in the manufacture of aircraft as we do in arms and munitions of war. Whatever other effect the European war has had, there is no doubt it has advanced the cause of aviation more than a decade of peace would have done. Here in this country, at the present time, we have five or six firms turning out, at the rate of two or three machines or more a week, first-class warplanes of high speed and great load-capacity, suitable for either scouting, bomb-dropping, or pursuing enemy aircraft, and fitted with American-built motors. Contrast this with affairs less than three years ago, when most of the same manufacturers were on the verge of bankruptcy, or else eking out a small income in conducting flying schools.

None of the belligerent countries in Europe gained their present high status in aerial matters without paying a heavy toll of lives lost in peace time. Deaths through flying were of weekly occurrence in Germany and France between the years of 1910 and 1914; while England suffered heavily also. The cause of many of these accidents is unknown; but officials of the Aero Clubs of each of these countries constituted themselves into a board of inquiry after every disaster. Through a careful study of the wreckage after each fatality, defects in construction were often found out and remedied. Consequently, few of those early pioneers suffered in vain. Trick-flying was never encouraged much in Europe. The tendency was rather for long-distance and non-stop records and for speed-races. In Germany, Switzerland and England, military aviation was a thing apart, and the training was very rigorous and thorough. Nothing short of a 60-mile gale was allowed to prevent officers from making daily flights.

The exploits of Pegoud, the famous French flyer, which culminated in his flying upside-down and looping the loop on an ordinary 50-horse-power Blériot monoplane, were not made primarily to draw huge "gates," but were the culmination of a series of experiments and theories of M. Blériot made in order to test his type of machine in the face of any weather conditions it might meet. All the accidents that have occurred since in this country to "loopers" have been occasioned through weak and faulty machines designed by men with no theoretical knowledge of aeronautics rather than by any lack of skill on the part of the performers.

It is doubtful whether flying will ever become as safe and as common as automobiling, or that the "fool-proof" aeroplane will be built for many years. But then neither is boat-sailing or any kind of sea-navigation "safe." The main thing is to build sturdy machines with strong landing gear and a variable range of speed so that they can be brought up in a small area. And above all to find out the most reliable motor. Both these problems are by way of being solved shortly. A long way has been traveled since the days of the old box kite type with the pilot's seat in front where he was exposed to every zephyr, and the modern 150 horse-power water-cooled engined biplane with enclosed fuselage, and seats for machine-gun operator and observer, capable of any speed from 35 to 95 m. p. h., the variation of which is caused by slightly altering the angles of the wings or planes.

The present status of our army air service does not indicate that our Government has made any serious effort to keep pace with the game. For the Mexican expedition only eight aviators were available. In spite of the fact that Villa had no anti-aircraft guns, these machines lasted about two weeks. Under ordinary conditions of use with a first-class power they would not have lasted a week. The wastage in this branch of the service is enormous. Eight or more army aviators are taking their certificates in England every week. So if we are not to be hopelessly outclassed in this very important field, it behooves us to act, and to act quickly.

Kauri Gum Oil—New Zealand's Substitute for Gasoline

A COMPANY has been organized to extract kauri gum oil from peat taken from the swamps in the northern part of North Island, New Zealand, where kauri gum has been mined for many years.

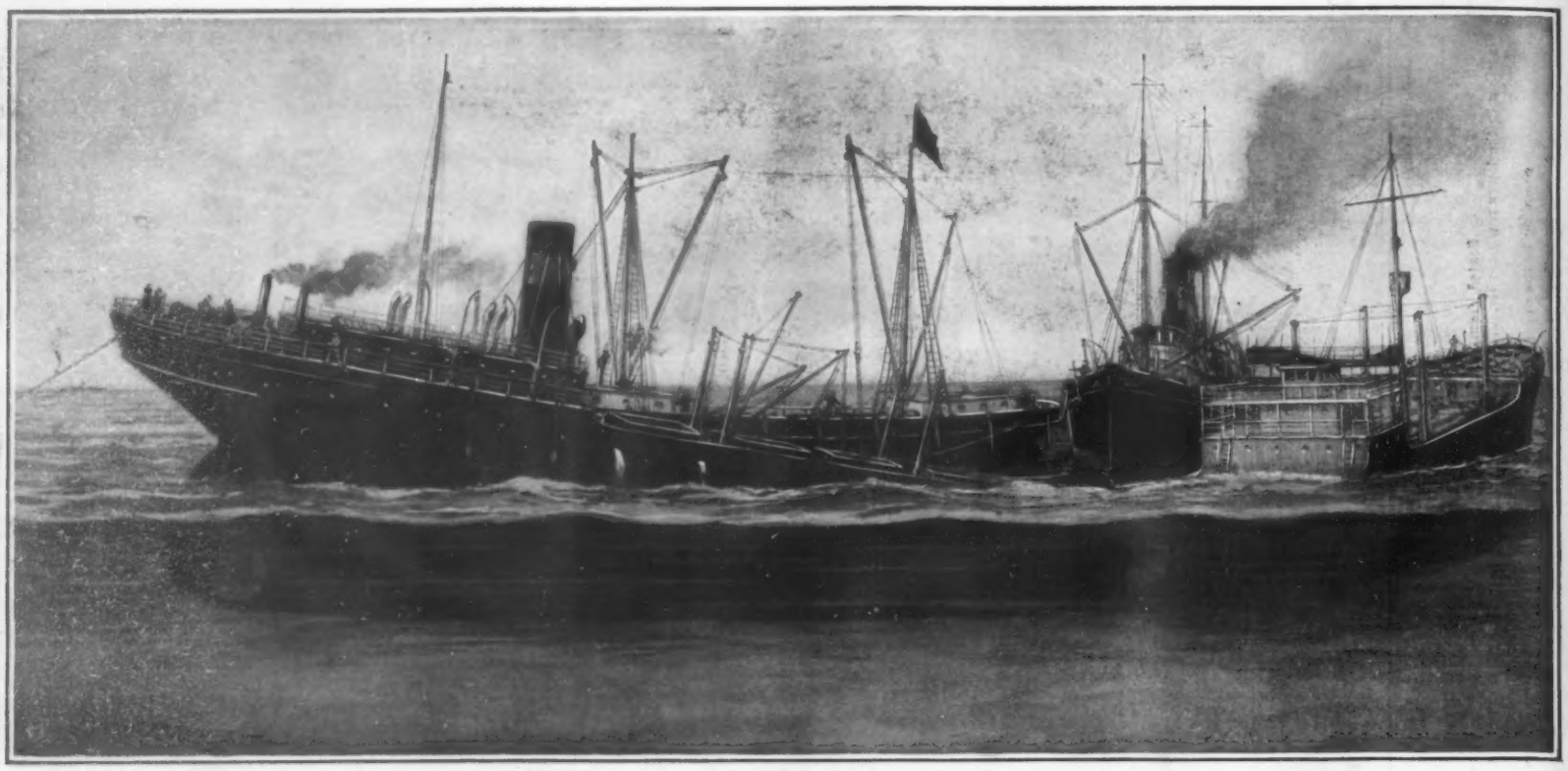
Some years ago a company was formed for this purpose and machinery installed and the plant was worked for some time, but not with favorable results, since the methods adopted and the machinery installed were not well suited for the work, so it was finally given up for a time.

It is claimed that the peat yields 20 to 30 gallons per ton, of which about 25 per cent resembles gasoline or benzine, which is being used for motor cars and launches at this time. The remainder contains some 28 different kinds of heavy oils, some of which make exceptionally good varnishing material. It is further stated that in the north of the island are found extensive beds containing much fine kauri gum particles, and are rich in materials producing this kauri gum oil, as well as kauri gum that may be extracted from the deposits.

Scene in office of Secretary of the Navy at the time of legalization of members of the Naval Consulting Board as officers of the Government

Under legislation recently passed, Congress has given full authorization to the activities of this non-partisan body of distinguished American scientists and engineers.

Seated, from left to right, are: Mr. Thos. A. Edison, The Secretary of the Navy, Mr. W. L. Saunders (on desk), Dr. A. G. Webster, Chief Naval Constructor Taylor, Mr. Howard E. Coffin, Mr. Hudson Maxim, Admiral Benson.
Standing in the lower row are: Dr. R. S. Woodward, Asst. Secy. Roosevelt, Chief of Bureau of Yards and Docks F. R. Harris, Mr. Peter Cooper Hewitt, Mr. Thos. Robins, Mr. Spencer Miller, Dr. M. R. Hutchison, Mr. W. L. Emmet, Dr. L. H. Baekeland, Mr. Lawrence Addicks, Mr. F. J. Sprague, Mr. A. L. Riker, Comdr. R. H. Leigh, Asst. Chief M. & S. Surgeon Holcomb, Rear Admiral L. S. Palmer, Col. Lejeune, U. S. M. C.; Lt. Byron McCandless, Aide to Secretary.
Standing in the upper row are: Paymaster-General Samuel McGowan, Capt. W. S. Smith, Mr. A. M. Hunt, Mr. Bion J. Arnold, Mr. Mathew B. Sellers, Capt. Ridley McLean, Mr. Elmer A. Sperry, Dr. W. R. Whitney, Rear Admiral Joseph Strauss.



Salvage operations on the wreck of the U. S. Collier "Hector," showing the stern floated and being pulled around to face the seas coming from the northeast

Salving the U. S. Collier "Hector"

TO the south-southeast of Georgetown Light, some 40 miles from Charleston, South Carolina, on a shoal or sandbar over which there is about five fathoms (30 feet) of water, lies the hull of the U. S. Collier, Hector." She was driven upon the shoal by the furious hurricane which swept the coast on July 14th. It was the after part of the ship which took bottom and was held fast. The forward portion of the ship, which was deep laden with 11,000 tons of soft coal, yielding to the side thrust of the heavy seas, broke cleanly apart and was swung around, somewhat as shown in our illustration.

The "Hector" had sailed from Charleston carrying a crew of 82 men, with 60 marines, a total of 142 souls, all of whom were saved by the tug "Wellington" and lighthouse tender "Cypress."

Surveys were made and the Merritt and Chapman Derrick and Wrecking Company began the work of salvaging the ship. The wrecking tug "Rescue" and an ocean wrecking barge, with all necessary apparatus, including 15 pumps, air compressors, etc., were despatched to the wreck. Operations for saving the ship were begun. Anchors were laid, cables bent on, and the pumps, compressors and boilers were set up on the quarter deck, as shown in our drawing. The engine and boiler compartments in the extreme after portion of the wreck, and the adjoining hold, number five, were pumped out, bringing the stern up to the position shown in the illustration. Then, by means of the anchors and cables, the stern was pulled around until it lay in a northeast direction and faced the prevailing seas. This was done to enable the wreck to take the seas stern on and save the hull from the severe buffeting it would receive if it took them on broadside.

Sketch showing wreck with after portion pulled around end on to the prevailing seas

It was the purpose of the wrecking company to make tight the bulkhead between holds four and three; jettison the coal in holds four and five; pump them out and float the after section, compressed air being used to assist in bringing the wreck to the afloat condition. The same methods were to be used on the forward section.

All that was necessary was a suitable spell of calm weather; for it must be remembered that the wreck lay 40 miles off shore, and because of the shoal, any sea that was running was particularly bad for wrecking operations, as will be shown in the work performed.

Unfortunately, with the exception of the first stretch of nine good working days, the successive spells of calm were very short, and the work of repairing the smashup of gear and plank during the recurring rough weather occupied the whole of the following period of calm. The log of the wrecking operations shows how discouraging were the conditions. After the first spell of nine working days, the next five attempts yielded successively only three, two, three and five good days. This was followed by spells of only one or two days each; and it was realized that there was nothing for it but to abandon the work for the winter months and wait for the spring season.

So the good ship "Hector" will have a long battle of it with the stiff nor'easters of the winter months, and if the frames and plating can stand the buffeting, the work will proceed as above outlined when gentler winds prevail.

Then, if all goes well, the wreck will be floated and towed to a drydock, its halves lined up, and the good ship made whole for another spell of useful service.

The two halves of the U. S. Collier "Hector" with decks awash

Decimal System Advocated for British Empire

SPECIAL interest in the possibility of adoption of the decimal system of weights, measures, and currency throughout the British Empire has been created by a resolution voted at a special business conference of the British Imperial Council of Commerce, held in London, England. The resolution passed was as follows:

"That the British Imperial Council of Commerce be requested, by representation to the Imperial and Dominion Governments, and otherwise, to make every effort to bring about the adoption throughout the empire of a uniform decimal system of weights, measures, and currency, in order that trade relations with foreign countries may be developed and extended."

The meetings in the course of which the resolution was adopted were attended by representatives of leading chambers of commerce and boards of trade of the British Empire. Action on this same subject was taken up by the Association of Chambers of Commerce of the United Kingdom some time ago.

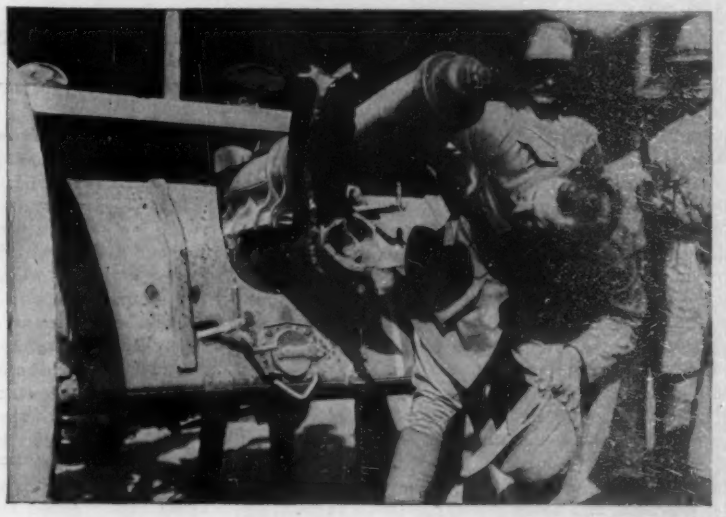
Dromio Crabs

AN interesting crab is the Dromio Vulgaris or so-called "sleeper" crab, for in fact it has very slow movements. This crab is abundant in deep water in the Mediterranean region, and is found at 30 to 60 foot depths, being properly a southern species though it is sometimes found in the English Channel. Like many other crustaceans, it dresses itself out with foreign substances, for instance water plants, in order to disguise its presence. M. Topsent relates his experience with some of these crabs, and says that when captured they usually have the body covered with a variety of sponge, *Spongelia fragilis*, so that it is very difficult to detect them, especially as they have the habit of remaining motionless, and thus they secure a very good protection. In contrast with the oxyrhynchus which allows the sponge to grow naturally upon its back, the present crab only holds it on its back by the use of the small hind claws. The observer removed the sponge and put the crabs in a water tank in which there were colonies of *Alcyonium digitatum* growing and next day he found the crabs bearing the alcyonium upon their backs, having cut this off during the night. On the other hand M. Bohn observes that the Dromio of the St. Marcouf region cut off the large-leafed sea weed in the water and use it as a mantle for their backs.

Many other instances of the same kind could be mentioned.

Copyrighted International Film Service

THESE British soldiers at Saloniki are preparing a little surprise in the form of a bomb for their enemy in a nearby trench. The bomb is to be thrown by means of a conventional form of trench gun, which the man at the extreme right is in the act of pointing by means of an elevation indicator mounted on its barrel.



Copyrighted American Press Association

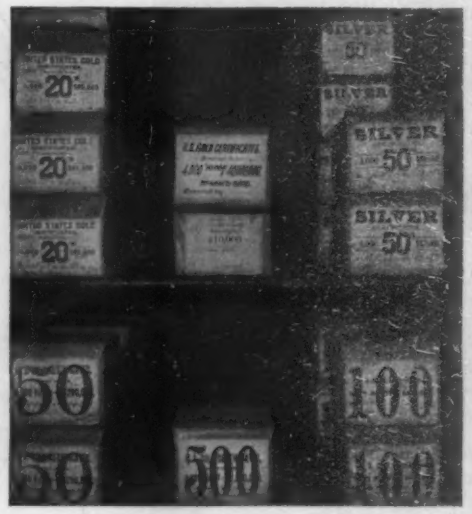
THE need for extreme care in munition making is graphically presented in this view. The barrel of the cannon has been ripped apart by the premature explosion of a shell passing through it, due to a faulty fuse. Despite the obvious force of the explosion, which tore the steel as so much paper, none of the gun crew was injured.

PICTORIAL NOTES

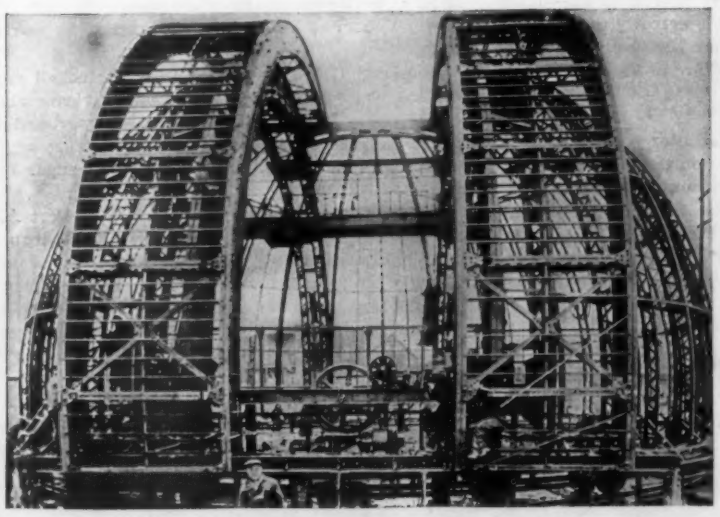
FOR its many tribulations and heroic defense, the shell-torn city of Verdun has earned these orders of the Allied countries—a rare tribute, indeed. Appearing in the order shown are the decorations of Russia, England, France, France again, Italy, Serbia, Belgium, and Montenegro, encircled by the tricolor ribbon.

Copyrighted American Press Association

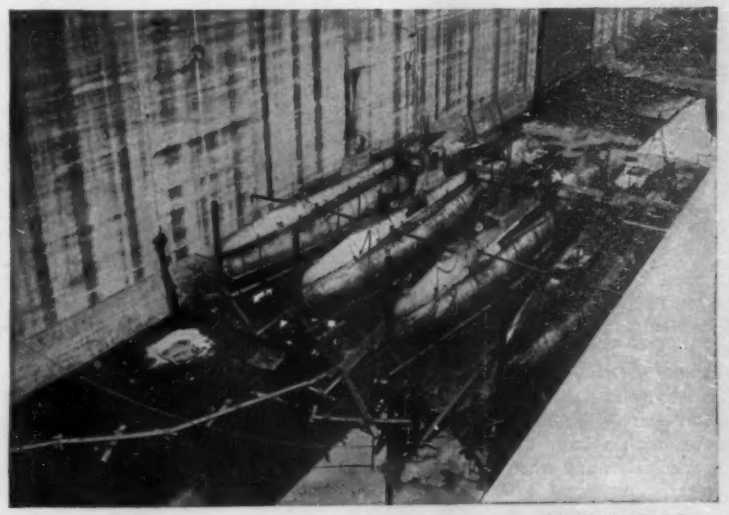
HE crowed too much, hence the "rooster muzzle." In order that a rooster crow successfully, it is necessary for him to stretch his neck to its greatest length. While this muzzle does not prevent the rooster from pecking or scratching with his beak, it stops him from stretching his neck. Result: a noiseless rooster.



ON these shelves, and many more like them, the United States Government stores the newly printed paper money until it is released for circulation. Carefully counted, the bills are wrapped into packages and sealed. These packages bear a label giving full particulars concerning the contents.



WHEN this steel framework is covered over and converted into the observation tower of the new Dominion Observatory at Sarnitch Hill, British Columbia, it will house the second largest telescope in the world. The instrument will have a lens measurement of 73 inches, and its tube will be sufficiently large for an automobile to pass through.



Copyrighted Brown & Dawson

NOT in a dry dock but in one of the locks of the Panama Canal are these United States submarines, high and dry, for inspection and repairs. These underwater boats of the *C* class are quite at home in this novel berth, proving that the Panama Canal locks would be available as improvised dry docks, even for large vessels, in times of emergency.

The Heavens in November

A Newly-Discovered Star that Holds the Speed Record for Apparent Motion

By Prof. Henry Norris Russell, Ph.D.

A RECENT number of the "Astronomical Journal" brings a full account of a remarkable discovery by Prof. Barnard, which was announced with fewer details early in the summer.

While comparing photographs of the heavens made at different times, a star visible on one of the plates was found to be missing on another. This was not surprising, for many stars vary in brightness and are at times too faint to be easily seen. But on the second photograph, taken in a later year, a second star appeared, some little distance due north of the missing one, in a position where nothing was shown on the earlier plate. On looking up a third plate, made at an intermediate date, no star was found in either of these positions; but a star, about equal in brightness to either of the others, appeared on the line joining the earlier and later positions, and about midway between them.

It was now clear what was the situation; there was only one star, after all, and it did not vary in brightness, but was in motion, shifting its position steadily northward from year to year, so that it appeared in a different position on each of the three plates.

The mere existence of such a motion was not at all surprising, for all the stars are moving more or less; but the rate of motion was unprecedentedly rapid—for a star.

During the 22 years intervening between the earliest photograph in 1894, and the time of discovery, it had moved northward by nearly four minutes of arc, or at the rate of a little more than ten seconds of arc per year.

To the ordinary reader, this may seem a very slow motion, for at this rate the star would take 350 years to move a single degree in the sky.

But to astronomers the announcement came as a decided surprise, for this motion was more rapid than that of any star previously known among the thousands and tens of thousands which had been observed.

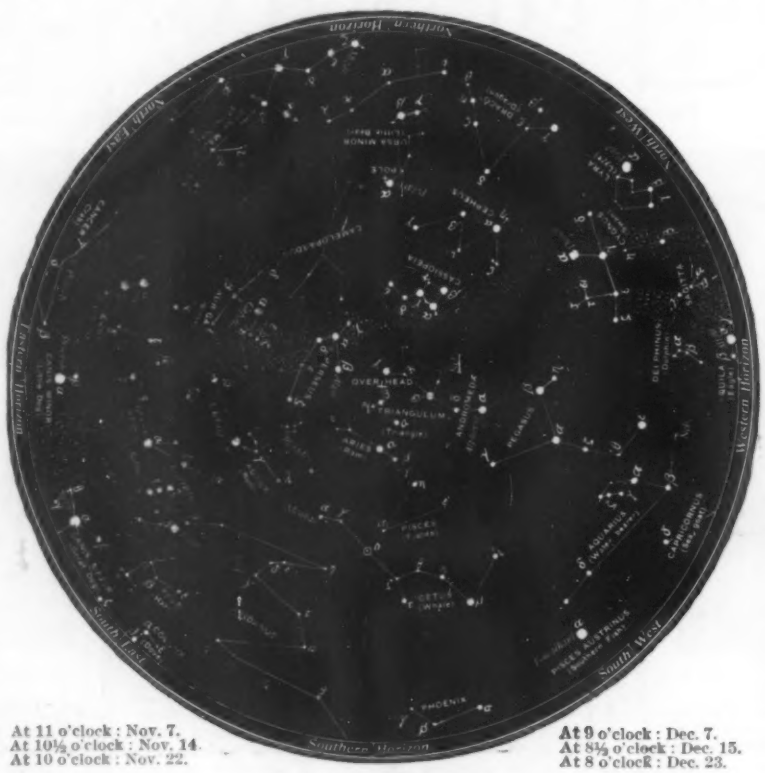
The fastest motion previously known belongs to a star invisible to the naked eye, and too far south to be observable in our latitude, which is known only by its number in the catalogue of stars prepared by Gould, in which its position was first recorded. This star moves 8¾ seconds of arc every year. Next to it come two other stars, also invisible to the naked eye, one in the northern heavens and one in the southern, having "proper motions"—as these rates of motion are called by astronomers—of about 7 inches per year. There are about a dozen others with motions of between 3 inches and 6 inches per year—of which only one, Alpha Centauri, is conspicuous to the unaided eye, though three or four others are visible without telescopic aid.

Hence this new "find" of Prof. Barnard's is a decidedly remarkable object. Like most of the other rapidly moving stars, it is faint. It is, in fact, between the 9th and 10th magnitudes, and so inconspicuous that it has never been recorded or observed in any of the catalogues of stars so far published, and is still therefore without a name. Had it not been for the records preserved upon the photographic plates, this very interesting star might have gone for many years more without any one's making the observations of its position which would have been necessary to detect its motion.

The star is, as has been said, a faint one, though perfectly well visible in a three-inch telescope. It is in the constellation Ophiuchus, in R. A. 17h. 53m. 43.6s., and declination 4°, 27′, 48″, north of the equator—which puts it about 2½° east and 1¾° north of the bright star γ Ophiuchi. It is in a rich region of the Milky Way, and so would be hard to find without a good star-chart.

Viewed with a large telescope, it shows a conspicuous orange color, and when examined spectroscopically, its spectrum is found to be of the type denoted at Harvard by the symbol Mb—which, in non-technical language, means that the star belongs at the very bottom of the temperature series, its surface being nowhere nearly as hot as the carbons of an electric arc, and perhaps hardly hotter than the filament in a tungsten lamp. Though this seems hot enough from the laboratory standpoint, it is merely a "dull red heat" from the standpoint of the stars—as anyone may convince himself by looking at a distant tungsten lamp at night, and comparing its color with that of the stars.

The same observations that have informed us of the star's low temperature, also show that it is approaching our system with a high velocity, about 110 kilometers, or nearly 70 miles, per second. Moreover, from the relative intensity of certain of the dark lines of calcium and other metals in the photographed spectra, Professor Adams at Mount Wilson, applying the beautiful method which he developed a year or two ago, has concluded that the star must be in reality, as well as in appearance, one of the faintest known, probably about 1-500 as bright as the sun—a conclusion fully confirmed by the work of Professor Campbell at the York Observatory. This makes it possible to estimate its distance, which comes out something like 15 light-years, or a little less than a million times the distance of the sun. All the observers of stellar parallaxes—who now are numerous—have doubtless put this star on their lists, and by a year from now we should be in possession of two or three good measures of its distance.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9¼ o'clock: November 30.

NIGHT SKY: NOVEMBER AND DECEMBER

There can be little doubt that it will turn out to be one of the near neighbors of our sun; but, on the basis of Professor Adams' estimate, it is not probable that it will prove to be the very nearest of all—unless indeed it happens that the star is actually so faint that the spectroscopic relations, deduced from a study of the brighter stars, do not exactly apply in its case.

The Heavens

The full glory of the grand winter constellations is now revealed. Orion is well up on the southeast, bearing the two great stars Betelgeux and Rigel in his shoulder and his knee, while the line of his belt points upward to Aldebaran and the Pleiades, and downward to the resplendent Sirius, which has just risen.

To the left, almost due east, is the smaller dog-star, Procyon, above which are the Twins, Castor and Pollux, and still higher, the great Capella, in Auriga—brighter than any star in sight except Sirius. Below Castor and Pollux and north of Procyon, is the planet Saturn, which looks brighter than any of the three.

The Great Dipper is low in the north, while the Little Dipper hangs by its handle from the Pole-Star. Draco is near the northwestern horizon, while Cepheus and Cassiopeia are high above the Pole. Cygnus and Lyra are conspicuous in the northwest, though the latter is getting low. Altair has just set, leaving Fomalhaut as the only bright object on the whole southwestern sky.

Pegasus is high in the west, and Andromeda and Perseus are almost over head, with Aries to the southward. Jupiter, which is on the southern part of the last-named constellation, far outshines anything else in sight. Below him, in the southern sky, is a huge area, occupied by Cetus and Eridanus, without a single really bright star.

The Planets

Mercury is a morning star at the beginning of November, rising about an hour earlier than the sun, and perhaps just visible. He very soon disappears in the twilight, and does not come into sight again this month, for, though theoretically a morning star after the 23d, he does not rise early enough to be seen before the dawn is bright.

Venus is a morning star in Virgo, rising at 3:35 A.M. on the 15th, and is the most conspicuous object in the morning sky.

Mars is an evening star, but so near the sun and so far south that he is unobservable.

Jupiter is in Aries, just past opposition, and well observable all through the evening. Saturn is in Cancer, rising a little after 10 P.M. at the beginning of the month, and at about a quarter past eight at its close.

Uranus is in Capricornus, and is still observable in the early evening, though with difficulty. Neptune is in Cancer, a little east of Saturn, and observable in the morning hours.

The Moon is in her first quarter at 1 P.M. on the 2d, full at 3 P.M. on the 9th, in her last quarter at 8 P.M. on the 17th, and new at 4 A.M. on the 25th. She is nearest us on the 27th, and farthest away on the 15th. During the month she passes near Uranus on the 2d, Jupiter on the 8th, Saturn and Neptune on the 15th, Venus on the 22d, Mercury on the 25th, Mars on the 26th, and Uranus again on the 30th.

Wolf's Comet, whose orbit was described a few months ago in these columns, has come into sight again (telescopically) in the morning sky—or will do so, at least, by the end of the month—its predicted position on November 29th being 15h. 6.7m. in R. A. arc—5°, 7′ in declination. It will then still be more than 350,000,000 miles away, but will be three times as bright as at discovery and steadily growing brighter. It will remain a telescopic object for many months yet, but will probably be visible to the naked eye next summer.

Princeton University Observatory.
October 23rd, 1916.

The West Indian Hurricane

THAT the recent cyclonic disturbances in the West Indies, already mentioned in these columns in connection with the destruction in San Domingo harbor of the United States armored cruiser "Memphis," were of an exceptionally severe nature is indicated by the report of the United States Consul at Port Antonio, Jamaica, who writes as follows:

The estimated average loss to the principal crops in the island as a result of the recent hurricane amounts to: Bananas, practically 100 per cent; ground provisions, 50 per cent; cocoanuts, 40 per cent; cocoa, 25 per cent; other fruit, 15 per cent; and sugar cane, 5 per cent.

A public meeting was recently held in Port Antonio for the purpose of starting an agricultural loan bank, from which small sums of money may be advanced to the smaller proprietors to aid them in replanting their lands. Nothing definite has been done up to this date, but shares in the proposed bank will be offered for sale shortly and it is hoped by this means to get sufficient funds to start the bank.

All fruit boats arriving since the hurricane at this port have departed empty for Cuba or Central America to get cargoes there for the United States, and no ships are now calling here except the three small freighters that ply regularly between Jamaican ports and New York. With the exception of a small lot of cocoanuts and very little cocoa taken by these ships, no shipment of any kind has been made from this port since the hurricane. So complete is the prostration throughout Jamaica that several of the larger steamship companies are closing their local offices and consolidating all business in Kingston.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Setting Up the Type for Fac-Simile Letters by Means of a Typewriter Keyboard

AN invention which, in its somewhat more limited field, may prove as revolutionary as the linotype machine has in the newspaper field, has recently been developed to the commercial stage by H. P. Hansen, a Dane of New York city. Mr. Hansen, who was formerly the owner of a Danish newspaper, had occasion to mail big batches of fac-simile letters in the advertising of his publication, and he soon found the printing of such letters by ordinary methods to be both slow and expensive. So he concluded that there was a dormant demand for an apparatus that would set up the type with the ease of typewriting—a veritable counterpart of the linotype, as it were.

The machine which this inventor has developed is said to be entirely successful. It has a magazine which contains the type made of the usual metal, and the individual types are released from the magazine by the operator, who manipulates a universal keyboard identical to that of the conventional typewriter. As the types are released from the magazine they are fed into a container so as to form a line, upon the completion of which the types are transferred by means of a lever directly to the type drum of the printing mechanism. With the work of composition finished, the printing can be done either by hand or by the power of a small electric motor. The type is inked by means of a ribbon so as to simulate typewriting more closely.

After the required number of impressions have been taken from the type, the type drum, which is made in the form of a segment, is removed and placed on top of the machine directly over a movable distributing mechanism. The slots in the printing and distributing devices correspond, so that the types slide by gravity from the former to the latter. The distributing device is operated by means of a 1/10 horsepower electric motor taking its power from an ordinary electric light socket. During the distributing operation the types are dropped into a selecting device which depends for its functioning upon the specific shape of each individual type, just as in the linotype machine the distributing device is based on the use of various combinations of teeth on the matrix molds. Thus the types of the new machine are automatically assorted and transferred into their respective channels in the magazine, where they are held until released again for further composition. The distribution is automatic: when the last type in the mechanism has dropped into the magazine, the power is automatically shut off and the operation is completed. The great advantage presented by this feature is that the operator does not have to remain in the office after closing time, while the type is being distributed. All that the operator has to do is to place the segment in position and turn on the current.

The fac-simile letter composing machine is about six feet in height and occupies little floor space. It is claimed that a single unit will do the work of 20 of the ordinary machines in use to-day for the same purpose. And so simple is the operation of the new machine that the average typist becomes an expert typesetter after a few minutes' instruction.

The setting up of fac-simile letter type and the automatic distribution of the type are performed by this machine

A Wooden Dog that Comes When You Call

THERE is nothing startling about the little toy dog that is portrayed in the first of the accompanying illustrations, except possibly his rather grotesque appearance which is decidedly of a cubist turn. And his wooden limbs, nailed rigidly in place on the wooden body, certainly indicate that he is quite inanimate, which opinion is confirmed when he sits hour after hour in his kennel without moving even an infinitesimal part of an inch.

But this state of affairs is only due to the fact that he is an obedient dog and has not been called out. For the moment a whistle is blown, or a harsh command is given, or a handclap disturbs the quiet of the room, this same wooden dog leaps out of his kennel, to the never-failing surprise and amusement of the beholders.

The mystery the laity attaches to any form of sound-operated devices has made the present wooden dog one of the most successful toys of recent years; and while it is true that its conception and development represent a high degree of ingenuity, the toy is comparatively simple when reduced down to its essentials.

The second illustration, depicting the kennel with its roof removed, discloses the mechanism that causes the dog to spring forward at the command of his master. When the toy is not being played with the dog stands at the entrance of the kennel, for reasons about to be explained. To prepare the toy it is necessary each time to push back the dog until the iron piece or armature *B* comes in contact with the pole-piece of a solenoid, *E*, which holds the armature against the tendency of the flat spring to throw it forward. It will be noted that the spring also serves as a support for the armature. Now ordinarily the current from the battery *A* does not pass through the solenoid or electromagnet, for the circuit is open; but the pushing back of the armature causes the circuit to be closed through a contact strip *D* and a contact point mounted on the iron armature, thus energizing the solenoid which holds the armature in place. In the circuit is included a highly sensitive microphone, *C*, mounted on the back wall of the kennel so as to face towards the entrance.

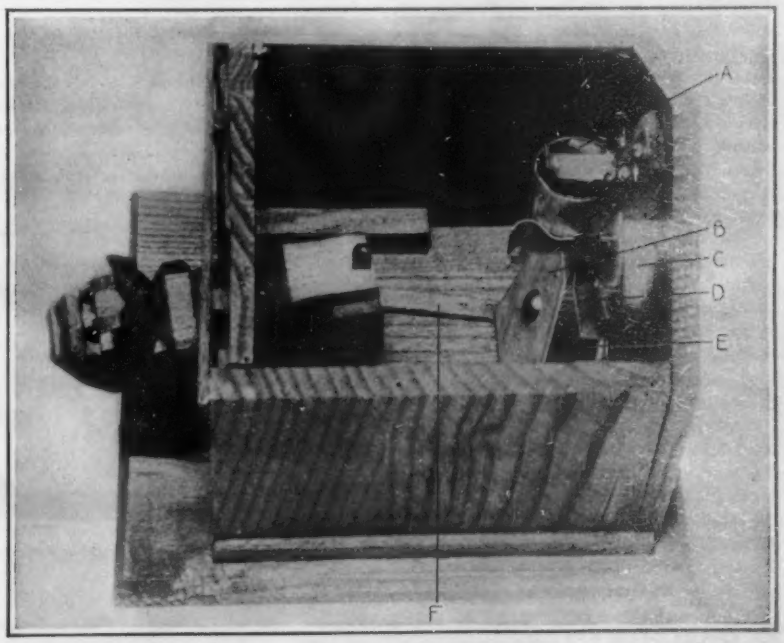
With the dog in place, he is alert and ready to respond to his master's command, which may be given by blowing a whistle, clapping the hands, or uttering some sharp word. The sound waves thus created travel through the air until they impinge on the diaphragm of the super-sensitive microphone, which in turn causes a variation in the circuit sufficient to weaken materially the magnetic flux of the solenoid and release the iron armature. The latter, thrown forward by virtue of its powerful spring support, pushes the dog out of the kennel to the amusement of young and old alike. The operation can be repeated by again pushing the dog back in position, which is facilitated by the two guide rails, only one of which shows at *F* in the illustration.

The super-sensitive microphone, which is the basis of the toy's successful operation, is most delicate, for the slightest tapping or rubbing of its diaphragm even with the point of a lead pencil or the edge of a card is sufficient to cause the release of the armature. Even the slightest moving of the kennel after the dog is in place is sufficient to operate the mechanism. On the other hand, sound waves caused by blowing a whistle or by handclapping can operate the toy up to ten or twelve feet away without difficulty.

A Proposed Russian Railroad

ACCORDING to the *Statist* of London, it is learned that a Russian railroad is projected to extend from Kem on the White Sea southeast to connect through Kotlas and Perm with the Siberian railway system. The total distance from Perm to Kola, the Arctic terminus of the new Murman Railroad, would be about 150 miles shorter by the projected route than by the present route via Petrograd. The new railroad is expected to facilitate the marketing of Western Siberian products in foreign countries through the port of Kola.

Most unique of the toys of recent years is this wooden dog that springs out of the kennel at the command of its master



The toy kennel with the roof removed, showing the sound-operated mechanism which releases the wooden dog

Utilizing the Pressure on Railroad Rails to Operate Electric Crossing Signals

UNUSUALLY ingenious is the design of a circuit-closing device invented by John Stuart Romig of Altoona, Pa., which depends for its operation upon the weight of a passing train on the rails adjacent to it. The device is intended primarily for the ringing of bells at crossings, although it may be employed to close any electric circuit for signal or other purposes.

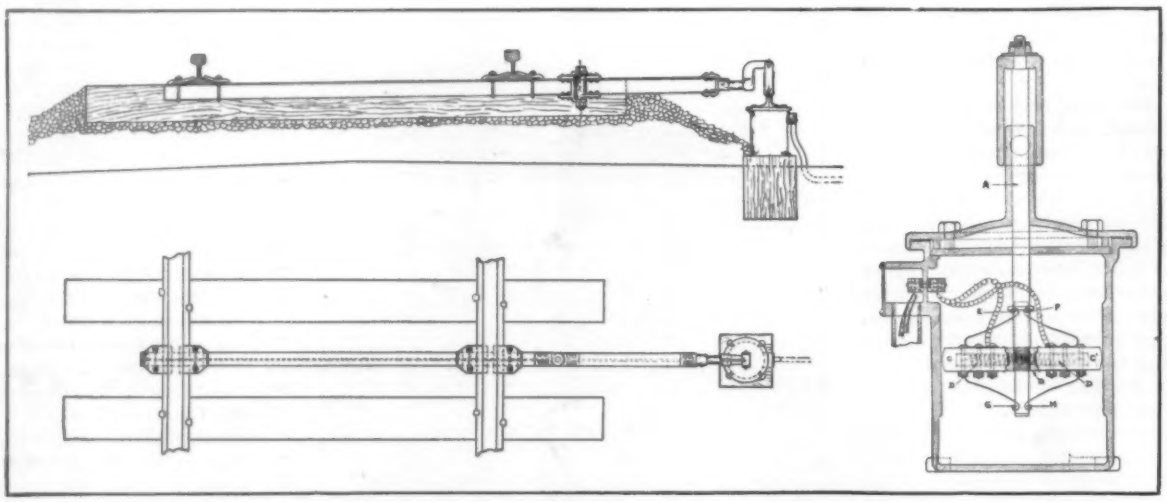
The commendable feature of the present circuit-closing device is that its installation does not require any alteration to the rails save the clamping of a three-inch I-beam on the under side of the track and between ties, as shown in the first drawing. It will be noted that the I-beam has attached to one of its ends a short arm, which is so hinged as to allow of longitudinal play of the rails. At the farther end of the arm is an arrangement of trunnions, links and swivel connecting to the plunger of the switch proper, which is installed at the side of the track.

It is known that the passing of a train over the rails causes the depression of the rails, even if ever so slight. If the pressure is equal on both rails, the extension of the I-beam arm is moved downwards; if the pressure is unequal, the arm still moves, either upwards or downwards.

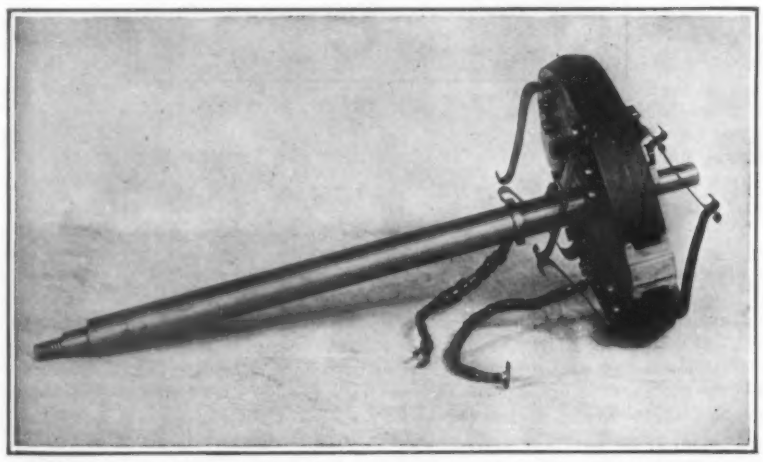
Within the iron casing of the switch proper passes the plunger rod *A*, on which is mounted a piston-like arrangement. The entire space within the iron casing is filled with a suitable liquid, preferably some form of oil. The piston, it will be noted from a close study of the sectional drawing of the switch, is made up of two rocking wings, *C*, *C'*, flexibly connected to the center member *B* which in turn is held on the plunger rod. Spiral springs, *D D*, pass through the rocking wings and cause the latter to hold a horizontal position under normal conditions. Eight flexible strips or contact springs, only four of which appear in the drawing, *E*, *F*, *G*, *H*, are mounted on the top and bottom sides of the two wings. The four contact springs or strips on each wing are connected in common and a bead-insulated lead taken off as shown. The two leads connect to posts passing through an insulating and liquid-proof partition, on the other side of which are connected the wires leading off to the batteries, relays, bells and other apparatus formiug the circuit. The plunger rod, it is well to note, is provided with a sleeve which slides over the neck of the switch casing, in this way preventing rust, dint, or other deteriorating factors from affecting the operation of the switch. The top piece of the casing is firmly bolted onto the main member in the manner indicated, precluding any possibility of damage to the operating parts within.

The operation of the switch becomes at once apparent when it is looked upon as a simple form of pump. The piston-like member, although touching the walls of the cylinder or container at but two points where projections slide in grooves to prevent the turning of the piston, allows but little space between its edge and the walls. As a result, the slightest downward motion of the plunger rod causes the pressure of the imprisoned liquid below to bend back the wings, bringing in contact either one or both pairs of springs mounted on top. If the plunger rod moves upward, the imprisoned liquid at the top causes the wings to be bent downward, bringing the springs below into contact. Thus the circuit is closed and the crossing bell or other apparatus operated. In the case of the former the circuit is so arranged that the closing of the contacts throws a relay switch into operation, keeping the circuit closed until it is opened farther up the line by the train. Obviously, the spiral springs bring the wings back into normal position when upward or downward motion ceases.

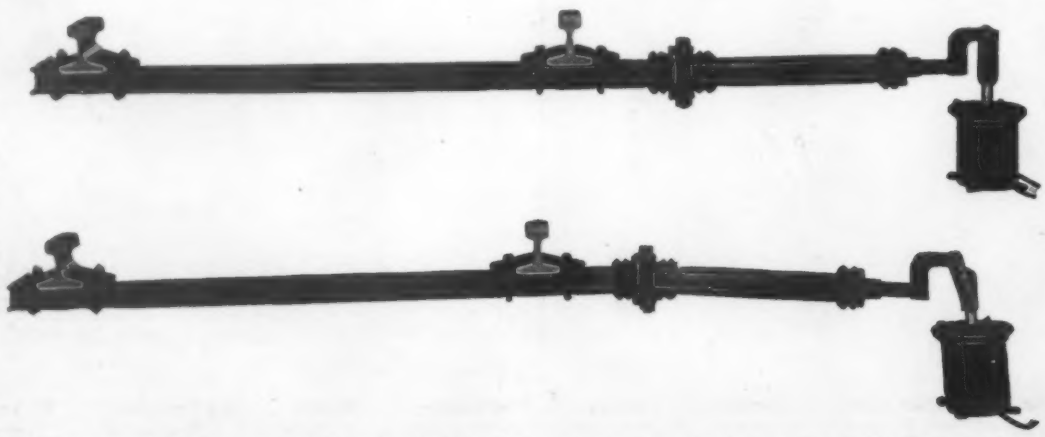
The mission of the auxiliary arm connecting the I-beam to the switch is to take care of the creeping of the rails. In one of the accompanying illustrations it will be seen that the rails have crept 18 inches longitudinally without affecting the operation of the switch.



Method of installing the pressure-operated switch for railroad switch, for railroad-crossing signals, and a sectional view of the mechanism of the switch proper



The contact-making member of the pressure-operated railroad-signal switch



Arrangement of pressure-operated track switch in relation to rails, showing the connecting arm in a straight line with the beam, and the connecting arm after the rails have crept 18 inches

The Current Supplement

THE current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2131, for November 4th, opens with a survey of *The Principle of Relativity*, a matter of importance in a great many branches of science. *Invisible Comets* deals with derelicts of the sky that long ago disappeared from view. *Certain American Turtles* is an interesting original paper dealing with the individual variations in their markings, and is fully illustrated by photographs by the author. The article on *Latent Life* is concluded in this issue. *Cross Channel Communication Between England and France* discusses the various plans that have from time to time been proposed. *Artistic Pottery in America* calls attention to one of the smaller industrial establishments where surprisingly beautiful specimens of workmanship are produced. It is illustrated by a number of unusually attractive photographs. *Bird Migration* tells of the wonderful journeys made by many species of birds between their summer and winter homes, and is accompanied by several charts showing the routes taken. *Histological Effects of Heat on the Eye* describes a number of interesting experiments made on rabbits eyes in an investigation of the subject. *Stabilizing Ships* discusses the results obtained by use of the gyroscope as compared with other proposed methods. There are also a number of shorter articles of general interest.

Will Stefansson Negotiate the Northwest Passage by a New Route?

THAT Vilhjalmur Stefansson, commander of the Canadian Arctic Expedition, may try to negotiate the Northwest Passage by a different and what is said to be a more commercially practicable route than that which Amundsen took, is the announcement of George H. Wilkins, who has been second in command to Stefansson for the past two years. Wilkins it was who, in an auxiliary schooner only 65 feet long, battled his way through the ice fields for 600 miles to Stefansson's relief, when the explorer and the two sturdy men who accompanied him on his trip over the ice of the Arctic Ocean from Martin Point, Alaska, to Cape Alfred, Banks Land, were almost universally believed dead. He was then promoted to be second in command.

Stefansson's ship, the "Polar Bear," at present lies in an advantageous position in Prince of Wales Strait, on the east coast of Banks Land. She is a staunchly built vessel, 85 feet long, and equipped with gasoline engines of 75 horse-power, and it is Stefansson's belief that if the 169 miles to Winter Harbor, across McClure Strait, can be successfully negotiated, the balance of the journey through Melville Sound, Barrow Strait, Lancaster Sound, Baffin Bay and Davis Strait, thence up the St. Lawrence to Montreal, will present no difficulties.

If Stefansson's boat is not wrecked by the ice, and the voyage is successful, it will be the first time in history that a ship has sailed from the Pacific into the Atlantic by either of the northern routes.

Wilkins reports that Stefansson now has with him 15 white men and 19 Eskimo, men and women, the men to kill game, drive dog teams and assist generally in the chores, and the women to sew skin clothing for all the members of the party.

Oil Will Not Dissipate Fog

PREVENTION of fog at sea in the vicinity of a vessel cannot be accomplished by the distribution of oil on the surface of the water. Reports of experiments along this line, as recommended by the Naval Hydrographic Office, indicate that such distribution of oil had no noticeable effect on the fog.

Four reports from naval vessels along the Maine and Massachusetts coasts and on the Delaware River provide the basis for this assertion. Off Marcus Hook, Pa., where there are a number of oil establishments, the U. S. S. "Melville" on her trial trip ran into a dense fog. Her captain reported that there was a thick film of oil on the water for miles around, but the ship was fog-bound 12 hours.

The "Exide"

Starting & Lighting Battery *for* Automobiles

The Servants of the Giant

THE spirit of the "Exide" Battery is the spirit of a Giant —*strong, active, dependable, enduring,* a literal "giant that lives in a box."

He is *your* servant—*proved* and *tried,* backed by the recommendations of the thousands upon thousands of motorists for whom he is working every day.

Yet he also has *his* servants. In order to make still more positive the reliability of his "day's work" he has established all over the country "Exide" Depots and Service Stations, where his servants reside. Each one of these servants is especially trained in knowledge of the Giant's constitution, just what it will do and just what it needs to keep it healthy and serviceable.

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If you want the ultimate of dependability in starting and lighting battery construction and service you will get an "Exide".

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RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

SELF-FITTING PETTICOAT.—W. EPSTEIN and S. N. EPSTEIN, 39 W. 32nd St., New York, N. Y. This invention relates to wearing apparel, and its object is to provide an improved skirt or petticoat to readily conform to different sized waists, at the same time insuring a proper fitting and hang to the garment, especially over the hips.

SCARF OR BOA FASTENER.—D. M. RAFFAFORT, care of Sol E. Ehrlich, 130 W. 25th St., New York, N. Y. A particularly specific object in this case is to provide a novel form of clasp and catch so designed that the ends of the scarf or boa can be easily and quickly connected or disconnected, and when the ends are connected they cannot become accidentally detached by reason of the novel form of the interengaging parts.

SOLE PROTECTOR FOR BOOTS AND SHOES.—J. C. HOCKER, Barnard, Mo. This invention is adapted for use by miners, lumbermen, stone-workers and, in fact, by all persons engaged in outside employment. It may also be constructed to act as an anti-slipping device in inclement weather so that the wearer is effectively prevented from slipping when walking on ice or smooth and treacherous surfaces.

Pertaining to Aviation

FLYING MACHINE.—A. H. SMITH, P. O. Box 214, Zionsville, Ind. The inventor provides a machine in which all stresses to which it may be ordinarily subjected are transmitted to the framing which is constructed and braced in such a manner that the strains imposed on it, must equal the crushing strength of the material from which the frame is made, before it will collapse.

Electrical Devices

THERMO ALARM.—C. R. LUMLEY, 1006 Alaska Bldg., Seattle, Wash. This device is for use as a fire alarm, and for any purpose, wherein it is desired to indicate the temperature of a place or places to a distant station, and wherein the arrangement is such that an open electrical circuit will be closed when the temperature of the place in which the alarm is used is raised or lowered beyond a predetermined point.

SIGNALING AND INDICATING DEVICE FOR HEATING PLANTS.—A. HEIN, 12 Zimmerstrasse, Berlin, Germany. This invention provides a portable apparatus which may be placed in a room where observations are to be made, this apparatus indicating what the temperature is, and the time that the normal temperature is reached. The apparatus is operated by an electric current with means for cutting off the current after the same has performed its work.

PROCESS FOR THE ELECTRIC TREATMENT OF CELLULOSE.—A. L. C. NODON, 12 Rue de Moulis, Bordeaux, France. This invention relates to a process for treating wood and other substances, such as ligneous matter, textile plants, textile matter, artificial silk, fabrics, paper paste, paper, etc., based on cellulose, so that they are not liable to putrefaction and also to increase their power of resistance.

COMMUTATOR BRUSH AND METHOD OF MAKING THE SAME.—R. L. SEABURY, Factories Bldg., Toledo, Ohio. The object of this invention is the production of an improved brush for use on commutators and collector rings of dynamo electric machines, which possesses good electrical characteristics and good wearing qualities and a good mechanical construction.

Of Interest to Farmers

SEEDING MACHINE.—W. R. PORTER, Agricultural College, N. D. An object of this improvement is the provision of a novel means for forming a furrow of uniform depth regardless of the unevenness of the surface or density of the soil itself whereby seed deposited therein will germinate evenly and thus produce a uniform crop.

SILO ROOF.—W. A. FARMER, Arcade, N. Y. In carrying out this invention, use is made of swinging side sections in forming the roof, said sections being provided with depending end members movable with the roof sections relatively to fixed gables on the silo at the roof. Provides means whereby the swinging roof sections may be opened or closed from the ground.

HOISTING BUCKET.—W. THOMAS, 1105 Market St., Beatrice, Neb. The aim in this case is to provide a construction of hoisting bucket into which the grain or other material is permitted to run, after which the bucket is hoisted by means of a suitable hoisting rope and is caused to travel along a track provided in the granary or building into which the material is to be transported and wherein it is stored.

Of General Interest

PAPER CUP HOLDER.— D. F. CURTIN, 927 Airdrie Place, Chicago, Ill. This invention is an improvement in sanitary cup holders, and has for its object, the provision of a simple, inexpensive device of the character specified by means of which cups or receptacles of paper may be held during their use.

SAFETY FASTENER.—W. P. MITCHELL, 64 E. 127th St., New York, N. Y. The device is designed for the purpose of sealing an envelope to prevent the opening thereof by any one except the party addressed, or to provide a means for detecting such surreptitious opening. It is obvious, however, that the device may be applied to various other packages, boxes, wrappers, bags, etc., sent by mail or by other conveyances for delivery.

BARREL RIM.—C. MOTE and F. C. UNDERWOOD, 406 Gordan St., Quitman, Ga. One of the principal objects of this invention is to provide a barrel rim of particular design with a reinforcing wire arranged especially with respect to the design of the rim in such manner as to effectually reinforce the same and maintain it against breakage.

Hardware and Tools

GATE LATCH.—A. A. STILL, Annette, Cal. In the present patent the invention is an improvement in the class of latches which are pivoted to a gate post in a horizontal position and adapted to engage the free edge of a gate

GATE LATCH

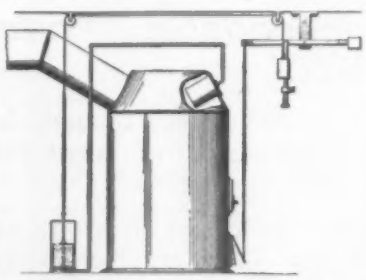
when swinging from either direction. The accompanying engraving represents a longitudinal section of the latch engaged with a lug applied to a swinging gate.

PIPE WRENCH.—J. C. LEONARD, Arroya Grande, Cal. This inventor provides a wrench with a casing to which a jaw is rigidly secured, another jaw which is curved being provided, the curved jaw having a rearwardly extending arm with teeth, with which mesh teeth on an arm of a lever fulcrumed to the casing, the other arm of the lever serving as a handle.

KEY RETAINER.—J. F. POLMANN, East Rutherford, N. J. One of the objects in this case is the provision of a device which is interengaged with a key-hole and so constructed as to prevent a key from being removed. Hence the device is interlocked with the key-hole, the device being so constructed as to be adjustable for key-holes of different sizes.

Heating and Lighting

AUTOMATIC HEAT REGULATING DEVICE.—E. B. JONES, Lima, Ohio. The principal object of this invention is to provide means whereby it is made possible to convert a part of the thermal energy of the fire into mechani-



AUTOMATIC HEAT REGULATING DEVICE

cal energy through the utilization of the expansive power of confined air when heated. Another object is to provide an arrangement of parts by means of which the derived mechanical energy is caused to automatically open and close the draft damper of the furnace.

DRIP POT FOR RADIATOR VALVES.—R. D. SNOWDEN, 427 Madison St., Brooklyn, N. Y., N. Y. An object of this improvement is to provide a pot or receptacle readily applied and removed from a radiator valve and adapted when in position to catch the drip, and also to cause the condensation of steam, whereby none of the steam or water can splash upon the floor or adjacent walls.

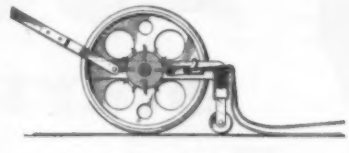
ELECTRIC FLASH LIGHT.—H. M. KORETSKY, Care of Bright Star Battery Co., 430 W. 14th St., New York, N. Y. This invention has for its general objects to improve the construction of flash lights so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed that the circuit can be kept closed indefinitely by the locking of the push button in closed circuit position.

Household Utilities

BLAST SAD IRON.—S. GOLDSTEIN, 208 E. 5th St., New York, N. Y. An object here is to provide a blast sad iron having a door which can be opened or closed with one finger. Another object is to provide a blast sad iron having a removable door and deflector, whereby the cleaning and fixing of the iron and its removable parts are greatly facilitated.

PAPER DISPENSER.—A. F. LESLER, care of Sanitary Toilet Co., 30 Church St., New York, N. Y. This improvement relates particularly to devices for dispensing in a sanitary manner paper which is required for individual use, and provides a structure which will cause or permit dispensing of separate pieces of paper to different individuals without permitting any contact of the paper, except by the person receiving the same.

CARPET BEATER.—E. SMITH, 18 Hoyt St., Newark, N. J. A specific object of the invention is the provision of a device which includes a novel arrangement of beating elements actu-



CARPET BEATER.

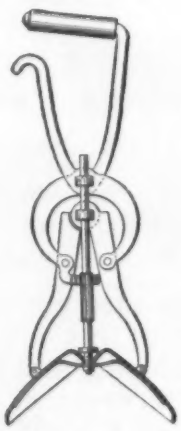
ated by a drum or cylinder which is provided with teeth so arranged as to periodically operate the beating elements as the device is wheeled over a carpet in a forward direction.

BAR SOAP HOLDER.—C. T. BONNABEAU, 1217 Hancock St., Brooklyn, N. Y., N. Y. The invention has particular reference to such holders as are adapted to economize in the use

BAR SOAP HOLDER.

of soap and to enhance the cleanliness of the devices with respect to similar devices commonly in use. It provides a soap dish or holder for attachment to the back of a washstand or the like, said holder comprising two separate parts, one above the other, the lower being arranged to receive the drip from the wet bar of soap and from which the drip water may readily be wiped.

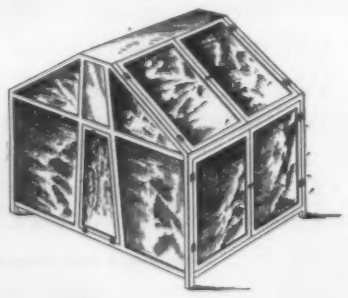
ICE CREAM CONE FILLER.—W. EICHELBERGER and W. W. BREWER, Pierce, W. Va. This improvement relates to the vending of ice cream, particularly in cones, and the object thereof is the provision of a device which will remove a predetermined quantity of ice cream



ICE CREAM CONE FILLER

from a can, mold the same into form to fit a cone and deliver the same to the cone without the necessity for the hands of the operator being brought into contact with the ice cream.

COOLING DEVICES FOR FOOD.—C. S. MUDGE, Echo, Ore. This invention provides a cooling device of attractive appearance which may be used to keep food cool and away from flies and other insects. The device is con-



COOLING DEVICE FOR FOOD

structed with screens, within which the food may be disposed, there being a curtain which is sprayed with water through which air is forced by a fan, the air which circulates in the device being kept cool and moist by this means.

Machines and Mechanical Devices

TOWEL DISPENSING MACHINE.—L. A. WEAVER, Bradford, Pa. The improvement provides a check or coin-controlled dispensing cabinet adapted to relieve the burden placed by statute, in certain States, upon the proprietors of hotels, restaurants, etc., requiring them to discard the use of so-called roller towels and supply their guests with individual towels.

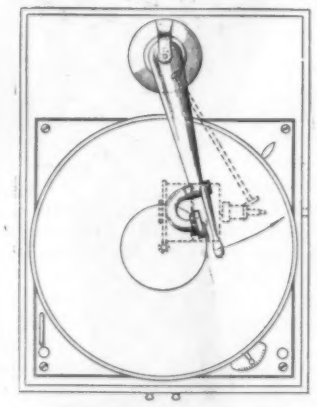
CHANGE SPEED GEARING.—G. Q. SHAMAN, 161 Manahan St., Brooklyn, New York, N. Y. The invention provides a change speed gearing more especially designed for use on automobiles and other power-driven vehicles and devices, and arranged to permit the operation by manipulating a middle shifting device to readily change a speed from low to a medium or to a high speed, or to reverse without moving any of the power-driven transmitting gear wheels out of mesh.

FLUSH VALVE.—G. Lamb, 500 Pacific St., Brooklyn, New York, N. Y.—The invention relates to flush valves especially adapted for water closets, and it is applicable to water closet tanks of either the overhead or low-down arrangement. It provides a combined guide gage for the float ball and clamp for the rubber seat, whereby the latter is held effectively in place and capable of adapting itself to the valve for water-tight fitting.

LIFE BOAT.—F. C. WALTER, care of Chas. P. Willard & Co., Winthrop Harbor, Ill. This invention provides a life boat having means whereby it may be readily and quickly covered so as to render the boat wave and storm proof. It provides a life boat having a plurality of shield sections which may be raised for completely covering the boat, in order to protect passengers from storm and from the waves. The boat may be manually driven without the use of oars.

Musical Devices

PHONOGRAPHIC MOTOR WINDING DEVICE.—L. FOOTE, Paraiso, Canal Zone. This invention provides means for winding the motor through the medium of the tone arm which carries the reproducer, whereby the swinging of the tone arm back and forth while the reproducer is in raised position will wind the motor through suitable mechanism between the tone arm and the usual winding shaft of the

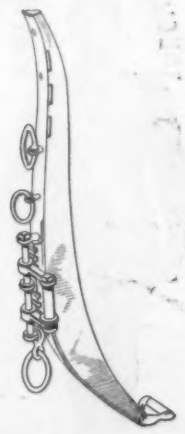


PHONOGRAPHIC MOTOR WINDING DEVICE

motor, such mechanism including a ratchet device whereby the tone arm is free to move inwardly from the periphery to the center of the record during the playing of the music, and, also including a friction clutch which yields when the motor is fully wound and before the tone arm is brought back to its extreme position.

Pertaining to Vehicles

ADJUSTABLE HAME AND TRACE CONNECTION.—W. MORGAN, 1121 3rd St., Havre, Mont. This invention provides for simple instantaneous adjustment of the trace attaching member with respect to the hame bolt, and its



ADJUSTABLE HAME AND TRACE CONNECTION

movable support in selected adjustment to regulate the point of draft and thus obviate angular strains upon the hame likely to cause sore necks and sore shoulders in its use.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Torpedo Deflector for Ships Under Way

(*Continued from page* 406)

of the last disk, that is the one in alinement with the barrel, is an idler disk which is pulled down every half-second by a magnet. When this idler disk drops, it permits one of the plate disks to roll into the barrel out of which it is projected by an air thrust, which amounts to 4,800 pounds. As soon as this disk plate is discharged, another plate takes its place and is retained by the idler disk until the latter drops at the end of the next half-second.

Of course as the disks are discharged half a second apart, the space between them, while traveling through the air, would be far greater than that shown in the drawing, but on striking the water they would be retarted, closing up the intervening space. The artist has taken the liberty of crowding the disks, in order to convey the idea of the practically continuous screen that would be formed under water.

The mounting of the battery of guns is such that the wall of disks will be formed at a distance never less than 20 feet from the ship's side. For the proper protection of the vessel it should have four batteries of guns, one at either side forward, one at either side aft. However, the after guns might be dispensed with, as most of the work would necessarily be done with the bow guns of a ship under way.

Photography With a Horse-Shoe Magnet

(*Concluded from page* 411)

arranged as in the original experiment, were placed in a light tight box and over the box were bound 25 thicknesses of black cloth. At the end of the 22 days all of these objects showed distinctly on the plate when developed. In this instance the objects are not quite as clear as they are in the plate, Fig. 2. This is due to the fact that, generally speaking, it takes a longer period to produce the same result when the plate is exposed in the air, as this one was, rather than in a vacuum, as was done in producing the three plates mentioned.

There can remain no question, then, but that the results produced in the plates are the effect of the magnet and cannot be traced to any other cause.

Photographing Interior Structure of Concrete Work

SOME successful experiments in photographing the iron reinforcements of concrete work with Roentgen rays, recently made by Inspecting Engineer E. Stettler of the Swiss Railway Department, are attracting much attention among Swiss construction engineers. The advantages of being able to make an examination of the condition of such reinforcements or the proper disposition and situation thereof without destroying the concrete structure are self-evident, as well as the desirability of being able to make an inspection of the position of the reinforcing iron rods upon the completion of the cement parts of a new building or a new cement structure.

Engineer Stettler, by the use of special plates adapted to any construction, has apparently obtained serviceable pictures of the inner structure of cement blocks. To eyes accustomed to pictures with great detail and much light and shadow, the first results of the Roentgen exposure may seem somewhat meager. However, the iron reinforcements in the pictures are shown in their proper size and situation, as are also the connections and crossings, so that imperfect connection can be clearly recognized.

A Chemical Laboratory on Wheels

EVERY thing that is used on a railroad begins to age and wear out from the moment it goes into use. To reduce this wastage to a minimum, by increasing the efficiency of the equipment, is one of the most important duties of the management of the railroad of to-day.

The chemical laboratory on wheels is the latest means to be employed to this end. The Pennsylvania railroad has just added a car of this nature to its rolling stock, and it is the first and only one of its kind in the world. The car is designed especially for the purpose of making tests and inspections of steel rails at the point of manufacture, to determine if they are up to the railroad's specifications.

When in use, the car is moved to a mill where rails are being rolled, and chemical analysis is immediately made of the finished rails. This work is done by a force of expert railroad chemists. This procedure has not only resulted in better stock, but also avoids the delays which at times occur in the operation of the mills, and which cannot be avoided without having a sufficient force of chemists on hand during the rolling process to see that the chemical requirements of the railroad's specifications are complied with.

Letting the Eye Train the Voice

(*Concluded from page* 410)

for those tones which have a rich timbre, such as the organ tone. The voice is less accurate when its volume is large (in terms of average error). Vowel quality affects the accuracy of vocal reproduction of tones. With women there is a general tendency to sing sharp; men are about equally divided in this regard. The average minimal producible change of the voice for men at 128 v.p.s. is about 5.5 vibrations, and for women at 256 vibrations about 3.5 vibrations. This conclusion obviously indicates a large enough field for cultivation of pitch control.

Some three years ago the author, while undergoing a series of voice pitch tests in Prof. Seashore's laboratory, was impressed with the accuracy of the tonoscope and the delicacy of the stroboscopic method. He became convinced that there existed a very great need for such an instrument, simplified, for use by the general public, at least that part of it at all interested in music. In particular such an instrument would be invaluable for use with children, insuring that their first impressions of the intervals of the musical scale shall be correct impressions. Students of singing and even professional singers are not without difficulties in singing on pitch.

There appeared to the author at that time two obstacles to the general use of the instrument by the public: viz., a lack of proper recognition by the public of its need, and the limitations of the Seashore instrument in its present form. Obviously one way to convince the public of its need is to place at its disposal an inexpensive and compact instrument possessing the greatest possible simplicity of construction and operation.

There were three immediate experimental objects in view. First, reduction of the drum in size to practically that of an Edison phonograph record (cylinder). Second, the replacing of the manometric gas flame of illumination by one that would use a beam of light from a vibrating mirror actuated by a diaphragm which was to receive its vibrations from the sounded tone. Third, the finding of a simple and compact driving engine for the drum. These three objects have been achieved in a portable and inexpensive instrument called the "tonodeik," which was demonstrated for the first time publicly before the meeting of the Iowa Academy of Science, held last April, at Des Moines.

The great reduction in size of drum means no loss in visibility of the stroboscopic effect. Clearly, the dots do not need to be ⅛ inch in diameter if they can be brought to the distance of most distinct vision from the eyes of the observer. This condition is made possible by a small drum, and it is obvious that the smaller dots can be sharply seen, for no reader of newspaper print has difficulty in seeing a period mark when it happens along, even if its size is small. In the stroboscopic effect on the small drum, moreover, one does not have to take detailed note of any one dot appearing stationary; all that need be detected is a row made up of separate dots, the row as a whole appearing stationary.

Experimentation with vibrating mirrors begun in February of the present year rapidly developed a new and more direct method of producing the stroboscopic effect. It was thought at first that a small mirror, mounted on an axis in its plane, could be made to vibrate by lever communication with a vibrating membrane, and thus cause a beam of light reflected from it to oscillate with considerable amplitude. This oscillating beam was to play across an aperture in a screen, beyond which was to be placed the small stroboscopic drum, so that the beam periodically flashing through the aperture should fall on the drum obliquely, illuminating it from end to end. Such a mirror was set up, and by rotating mirror analysis gave sine waves of several inches' double amplitude on the ceiling. The light reflected from the vibrating mirror and thrown directly upon a stroboscopic screen did not yield stroboscopy. Before extended experimentation with an aperture in a screen, the idea arose of using a mica membrane fastened across the end of a glass tube and permitting it to project in one direction for some distance beyond the outside wall of the tube. At the end of this projection a silvered circular microscopic cover glass as mirror was stuck against the mica sheet. It was supposed that the projection of the membrane might give a simpler lever action that would be useful. Light was reflected from the mirror to the wall, and it was noted that the mica surface itself reflected some light. When a tone was sounded by voice into the open end of the glass tube the light on the wall showed agitation, and that part of it coming from the mica itself inside the tube's cross-section was the most active. The silvered mirror was then transferred to this region. When the light from the mirror was now thrown on a stroboscopic screen very distinct stroboscopy was seen. The next step was to use a mica membrane itself silvered. This gave excellent results. The stroboscopic effect produced by this vibrating mirror method appears to be fully as distinct as with manometric flame. Since it uses reflected light the intensity of the light depends only on the intensity of the source. As far then as the distinctness of the stroboscopic effect depends on intensity of illumination this distinctness is limited only by intensity of source. The possibilities with the new nitrogen filled electric lamps, with their concentrated filaments, is apparent. The new stroboscopic method has a distinct advantage over the manometric flame method, for it employs an approximately parallel beam, whereas in the latter method the intensity diminishes with the inverse square of the distance. With this simple substitute of vibrating, or phonic, mirror method for that of the manometric gas flame the second object was achieved.

Also a satisfactory substitute for the special synchronous motor has been found. Such a degree of accuracy has been shown by this substituted driving arrangement that the error lies within 1/10 v.p.s. of a tuning fork. An accuracy greater than this is not claimed even for the tonoscope driven by special synchronous motor. It is reasonable to suppose that for all practical uses by the public, and even for most scientific purposes, an instrument with an accuracy of 1/10 v.p.s. will meet the needs.

In addition to reduction in size which makes possible a portable instrument, and the simplification of construction and operation, with decreased cost, the tonodeik represents other improvements. The illumination comes from the side (end) of the drum rather than from a point in front of the drum between it and the observer's eyes, as is the case with the instrument using the manometric flame. The drum and scale are at the distance of most distinct vision from the eyes. A single electric source (ordinary commercial current) serves for both winding of motor for drum and stroboscopic illumination, thus doing away with the acetylene tank that must be kept charged, and also dispensing with the flame, which is inherently subject to flickering because of unavoidable air cur-

rents. The electric current providing illumination may be either direct or alternating (the additional stroboscopic effect that one might expect to be present when A. C. is used is not present, at least noticeably, on the tonodeik drum). However, electricity is not necessary as an illuminant; any source of light of reasonable intensity may be used. The cover of the tonodeik with its hood makes unnecessary the running of the instrument in a darkened room. Also, the new stroboscopic method furnishes a rapid and effective means of testing the speed of the drum at any time. Furthermore, by the use of white stroboscopic dots with a dead black background greater contrast is obtained (hence greater visibility) than with the dark apertures on a metallic, reflecting background, as in the older instrument. Because of the predominance of black over white on the drum of the tonodeik the amount of light reaching the eye is a minimum, and this circumstance should mean a minimum of fatigue with prolonged observations.

One of the engravings represents an early experimental stage in the development of the tonodeik. Another shows the instrument in its present portable form, with stereoscopic hood and removable cover, ready to receive the plug of an extension cord from a lamp socket. Evidently the observer himself can sound the tone because of the flexible tube connecting mouthpiece and vibration chamber. Also, adjustment can be made with the tonodeik so that it is not necessary to place the lips in actual contact with the mouthpiece. Very distinct stroboscopy is obtained with the tone emitted under natural conditions of singing, with the lips at some distance from the mouthpiece.

"Dreaming against the future," one anticipates a perfected instrument of much diminished size, with a miniature stroboscopic screen that runs on jeweled bearings, whose extremely small dots in stroboscopic response are viewed through a magnifying glass. The speed governing devices will be as accurate as the delicate skill of the watchmaker can contrive them, and high accuracy should thus be obtained. The phonic mirror, minute and sensitive, to correspond with the other parts of the mechanism, will afford such high responsiveness that a tone sounded across the room will be sufficient for a precise reading of its pitch in the instrument.

Buttons as a By-Product of Beer

FOR many years the spent yeast which collected in immense quantities in the breweries and distilleries of Germany was looked upon as a bothersome waste product. Although a small proportion of this material found employment in the baking industry, the vastly greater part constituted an unmitigated nuisance. But of late this has been changed. In the first place, it was recognized that on account of its high content of albumen it was of potential food value. At first, on account of the bitter taste from the hops, the yeast was available only for use in the manufacture of articles like soup tablets. Later, means were found to remove this; so that by a process of sweetening and drying, a large variety of tasty and nutritive food-products were manufactured, suitable alike for human consumption and for use as fodders; and the entire yeast output of the breweries, amounting to ten million kilos annually, was in this way utilized.

Upon the subsequent discovery of means of increasing the albumen content of the yeast, the manufacture of yeast food products graduated from the ranks of subsidiary industries, and plants of an annual capacity of many million kilos were constructed for the sole purpose of the formation and conversion of yeast. Of the magnitude of these plants some idea may be formed from the fact that the cement vats for the generation of the yeast are the size of the largest swimming pools, and that the yeast compound stands two or three yards deep in them.

But even with this, says *Reclams Universum* for March 9, the surprises which the yeast has in store are not at an end. It has recently been found that on account of its plastic nature the yeast can be readily molded into any desired shape. This would at once suggest the possibility of a wide field of utility in the arts and in the manufacture of various small articles now commonly made of bone, horn, rubber, and various kinds of composition. The prospects of so utilizing the yeast did not at first appear encouraging. It was of a most unattractive dirty gray-brown color, and its consistency was not especially good.

However, after much experimenting, a process was discovered for dyeing it satisfactorily, as well as for graining it; and then means were found to control its texture within very wide limits. The worked-over yeast, styled "ernolith," has the form of a powder, which after dyeing, is hot-pressed into any desired shape. These shapes may then be worked over mechanically—may be sawed, scraped, filed, drilled, bored, turned, engraved, ground to a keen edge, polished to the last degree. The material has an extremely close structure, with a concholdal fracture, and it possesses sufficient hardness and elasticity for all ordinary purposes. Furthermore, it takes hold with a vise-like grip of metal parts pressed into it, so that wires, collars, etc., of metal may be firmly attached with minimum effort. As an instance of the advantage derived from this property, it has always been a matter of considerable difficulty to attach a metal shank to a bone or horn button. It has been necessary either to screw it in or to cement it in. With a button of ernolite, the shank is merely pressed in when the button is first formed, and it is then firmly fixed. Similarly all manner of animal and vegetable fibers—wool, cotton, asbestos, etc.—may be pressed into the substance of the ernolith.

The variety of articles which can profitably be made of ernolith is endless, and extends into all branches of artistic and technical work. Buttons, door-bell plates, knife handles, are just a beginning, suggesting at once extension to handles and wall plates of every description. While its greatest appeal to German consumers at present is due to its ability to replace to a large extent many of the materials which the war has made scarce on the continent, it will certainly remain in many of the fields which it has conquered, as a very cheap and very satisfactory composition.

Patents Issued on Collodial Bitumens

UNITED STATES patents have just been issued on an improved "bituminous substance," and on the process by which this product is manufactured. Similar patents have also been granted in Canada, Great Britain, France and Italy. It is believed that these are the first patents covering a product and process involving the introduction of colloidal matter into bitumens of all types. According to the inventor he obtains "an increased degree of body or stability in these bituminous substances, by means of the addition to and intimate and uniform dispersion through the bituminous substance of a proper proportion of a substance in the state of a dispersed colloid. The process consists in the introduction of clay in the form of a colloidal aqueous paste and combining this paste with the bitumen in such a way that when the water is subsequently driven off, the bitumen forms the continuous phase of the colloidal material.

The products resulting from this method of incorporating clay in colloidal form with bitumen has markedly different properties from these into which the mineral matter is introduced in the form of a dry powder, ranging all the way from materials resembling vulcanized rubber to plastic but at the same time very stable mixtures suitable for paving and many other uses.

Shammed Sickness

Some of the Dodges Used by Unwilling Soldiers

EVEN in times of peace the feigning of illness to avoid military duty is of fairly common occurrence. The tales of the "deaf" conscript who could not detect a loud explosion directly at his back, but was able to hear the recruiting officer inform him in a near-whisper that he might go, and of the man who insisted that a recent accident had left him unable to raise his arm above his shoulder, but was able to accede to the request of the clever sergeant that he show how high he used to be able to put it, occur to us in this connection. Actually enlisted soldiers are likewise found adopting various subterfuges in the hope of deceiving the medical service and escaping drill or other disagreeable assignments. Thus it is common knowledge among the members of many regiments that smoking straw will give a pronounced coating to the tongue, that beating the elbows against the wall increases the frequency of the pulse, that the introduction of cloves of garlic into the intestine leads to rise of temperature, etc.

After all, these are comparatively harmless. But in time of war such deceptions appear in a form aggravated by the seriousness of the duty which it is sought to avoid. Some of those who adopt these means in the effort to escape personal exposure are downright curs and scoundrels; most, however, appear to be merely men of extreme nervous sensitivity or of some psychological abnormality which makes the serious impairment of the health entailed by the methods adopted seem less fearful than the perils of trench life and the enemy's fire. It must also not be supposed that the proportion of such shirkers is considerable; to borrow the just expression of a recent writer, they constitute but dozens out of millions.

The ingenuity of these shammers is great and the list of ailments they have essayed to imitate is long. Certain of their deceptions have attracted considerable attention from doctors and military observers in general, so that we are in a position to go with considerable detail into the manner of their production, their symptons, and the means available for their detection.

It was in the African battalions of the French army, says Dr. Henri Bouquet in a recent issue of *Larousse Mensuel* that the imitation of jaundice by the use of picric acid was first observed, and it was here that it was made the object of a study of Drs. Garnier, Vallee and Rousille in April, 1914. The manner of acquisition of this "jaundice" has not varied since then. It consists always in introducing into the stomach in a protective shell of unleavened bread or cigarette paper a small quantity of picric acid, usually about 20 centigrams per dose. The addition of a little moisture aids the swallowing of this unattractive capsule.

The symptons vary in severity and duration according to the size and the number of the doses. The most important is the appearance upon the skin of the entire body of a greenish yellow discoloration, resembling closely a true jaundice. The mucous membranes are similarly affected, and there is diarrhœa, with headache, sickness at the stomach, biliousness and slackening of the pulse. The first cases which present themselves to the medical authorities of a regiment invariably give rise to the precise error in diagnosis sought by the patients, for there is nothing sufficiently unusual about the appearance of a case of jaundice or two to excite suspicion. But when the thing multiplies—as it invariably does in the face of the first success—attention is focused upon this veritable epidemic of jaundice, which can by no possibility be legitimate. Then, on more detailed examination, there is noted the absence of certain symptoms which invariably accompany jaundice when properly due to functional failure of the liver. Notably lacking are the fever and the itching of the skin; while analysis of the urine gives entirely different results, since in the one case the kidneys are called upon to discharge the functions of the liver almost in their entirety, while in the other they are merely required to rid the body of a stated foreign substance.

The ingestion of picric acid leads to a species of auto-intoxication, with results at times serious, especially to the liver. Another simulated malady of equal seriousness is an abscess artificially produced by the injection beneath the skin of turpentine or gasolene. Under proper regulation this idea has been profitably employed for the formation of abscesses of fixation, whose discharge aids in guiding a patient past the crisis in certain diseases; with unexpert handling, however, it has led to complications necessitating the amputation of the member on which the abscess had been induced.

As in the preceding deception, there are from the first indications which when duly observed should lead to suspicion of fraud. One of these is the appearance of a considerable number of lesions of this character as a unit. Another is the location of the seat of the trouble—the shammer seems always to select the thigh for this purpose. The abscesses thus produced present the three correct leading symptoms of fever, inflammation and pain, but the last item is greatly reduced, often to the point where no actual suffering is involved. The inflamed ganglia which should normally be present are missing. When the abscess is lanced, a wholly abnormal flow of pus results, carrying with it particles of gangrenous dead tissue; but withal the clotted pus is free from microbes—is aseptic, in fact. Finally, at the opening of such an abscess, the characteristic odor of the fluid employed in its provocation is almost invariably observed.

Drs. Nataletti and Roger have made note of another deception, namely, an imitation of erysipelas produced by rubbing the cheeks, forehead and sub-maxillary regions with some blistering substance, as thapsia. In this way are obtained a certain number of the symptoms of this disease, which could, however, deceive a physician but momentarily. In particular, there is produced a swelling and diffused inflammation of the skin, with minute vesicles, drying up rapidly into a fine yellowish crust. To any practised eye this little play is quite distinct from erysipelas, or in fact, from any other standard malady.

There remains to mention only the simulation of Bright's disease by injection of albumen into the bladder, and of mumps by prolonged physical or chemical irritation of the auditory canal. Neither of these devices has been used with any degree of generality, however.

America to Restock the World with Farm Machinery

THE last two years have been years of importance and of transition in our foreign trade. Our exports and our imports have increased in an unprecedented manner. The character of our foreign trade and the directions of our foreign trade have greatly changed. If our foreign trade of to-day is compared with that of 1913-1914 little resemblance will be found.

Nevertheless too many of us are apt to think that we had no foreign trade prior to the outbreak of the European war. As a matter of fact the United States stood third among the exporting nations of the world, and the recent great growth in our trade is really the climax of a development which has been going on for several decades. This is particularly true when we examine the character of our exports. From the nineties down to the time the war started the percentage of raw materials exported gradually decreased and the percentage of manufactured goods sold abroad increased from 20 to 47 per cent. Therefore, the comparatively small percentage of raw materials exported at the present time and the comparatively large exports of manufac-

tured goods can not be considered as something entirely new and unprecedented.

In considering the effect which the close of the war is likely to have upon the character of our exports, it seems quite certain that, for one thing, there will be a very large demand for agricultural machinery of all kinds immediately following the cessation of fighting. Europe, and for that matter, all of the countries of the world are to-day almost entirely stripped of their stocks of agricultural implements and machinery. The factories in the belligerent countries which have heretofore made agricultural machinery have been recently producing only a comparatively small proportion of their former output and some of them have almost entirely ceased to turn out agricultural implements. In some of the belligerent countries not only have the stocks of machines been exhausted, but agriculturists have been forced to resort to machinery of obsolete pattern and designs, and in some cases have even gone so far as to piece together odd parts which happened to be in the warehouse. It has been almost impossible for many nations to get the heavier products, among which the heaviest and clumsiest are agricultural machinery. The mere transportation expenses have been almost prohibitive. It will be our privilege and our duty to restock these countries with suitable machinery when the war is over.

There is another point which we should take into consideration and that is that the loss of men, the loss of labor power in Europe, has been great and irreparable. There is just one alternative if the belligerent countries of Europe and their colonies are to get back to the normal producing basis as it was before the war, and that is the use of labor-saving machinery. The largest number by far of the men who have been lost were engaged in agricultural pursuits. It is particularly important, therefore, that the European nations supply themselves with the very best labor-saving devices along the lines of agricultural implements, machinery, and farm-operating equipment. Already we see decided moves in this direction by the European nations. Not long ago we received a visit from a French commission, one of the members of which was an expert interested in agricultural machinery. He was here to see what labor-saving devices we could supply in connection with agriculture.

American Hardware in South America

A REPORT on the hardware markets in Chile and Bolivia was recently issued by the Bureau of Foreign and Domestic Commerce and is the first of a series based on the recent world-wide investigation of hardware markets by the American commercial attaches. The reports have been prepared under the direction of the attaches, but the technical information was collected by specially engaged experts in each country. In addition to the written reports thousands of dollars worth of samples were forwarded to the United States and have already been exhibited in the principal American hardware centers. They now form a part of the Bureau's permanent exhibit in New York City. This investigation is the first of a number of far-reaching, concerted studies to be undertaken by the attache service to assist American manufacturers in capturing foreign markets.

The report on Chile and Bolivia was prepared under the direction of Commercial Attache Verne L. Havens, whose headquarters are at Santiago, Chile. Mr. Havens finds that imports of hardware into his district have been interfered with by the war. There is a tendency to make the articles on hand go further than usual, and the lack of shipping that has interfered with so many lines has had its effect on the shipments of hardware.

During the normal year 1913-14 Chile imported a total of $3,750,000 worth of hardware. Germany led all competitors as a source of supply. England was second, and the United States was third.

A glance at the statistics shows that each of these countries had a decided advantage in certain articles. Chileans seem to put much more faith in American hammers, for instance, than in the hammers from Germany or England, and they are also partial to American hatchets, axes, files and rasps, rakes, scales, and balances, hinges, wire netting, wire nails, staples, sand-paper, and oddly enough, coffin trimmings. Germany, however, has the call in braces and drilling machines, measures, scissors and shears, razors, locks, railroad bolts, horseshoe nails, enameled pots and pans, carriage springs, lamps, and gas and oil burners. England has taught the native to prefer British-made drill bits, mining tools and repair parts, shovels, etc.

There seems to be no reason to believe that there will be a sudden increase in the amount of hardware used per annum, in Chile, but the tendency seems to be toward a better grade. Not a little American capital is being invested in mining, and the coming of these interests tends to increase the use of products from the United States. In addition to this the merchants are at present somewhat confused and anxious about their future supply, so much depends on the settlement of war difficulties. These merchants do not want to lose their clienteles. They must have goods and at present they are looking to the United States for a large part of them. Much of this temporary business can be retained by careful attention and fair treatment.

In 1913 Bolivia imported hardware valued at about $3,500,000 and at that time German manufacturers easily controlled the market. American products have been selling well since the war started, however, and it is thought that much of the newly gained business can be retained. American hardware has a reputation for high quality in Bolivia and all that is required is a willingness to grant terms similar to those to which the native firms are accustomed.

The report not only discusses general conditions in the two countries, but takes up in detail each article of hardware and describes the design most in favor and endeavors to account for its popularity. An attempt has been made to keep the work as practical as possible. It is entitled "Markets for American Hardware in Chile and Bolivia," Miscellaneous Series No. 41. In all there are 190 pages, including 12 illustrations of hardware articles in common use in the countries dealt with. Copies may be had at 25 cents each from the Superintendent of Documents, Washington, or from the nearest district office of the Bureau of Foreign and Domestic Commerce.

What Is T. N. T.?

WHAT is T. N. T? This is a question harbored by the minds of practically all close followers of the present European war. A few recognize it as a trade name of a very forceful explosive bought by Russia, England and France, on a very extensive scale from private corporations in America. It is really a gunpowder, properly called Tri-nitro-toluene. It certainly is a powder of very immense force; for, it is estimated that 80 pounds of it would sink any ship floating to-day. It is the strongest explosive now known. Just a few words about its composition and manufacture.

The compound toluene is an oil. It belongs in the benzol group, and it is gotten usually in the distillation of primary oil with the Rittman process of cracking oils. Its chemical formula is $C_7 H_8$; while that of benzene is $C_6 H_6$. T. N. T. is the resultant of the nitration of pure toluene with nitric acid, and its chemical formula is $C_7 H_5 (NO_2)_3$.

The nitration is done in lead kettles lined inside with lead coils through which either cold water or steam may be passed. Lead is not acted upon by the nitration mixture as iron; therefore, it gives longer and better service. This unique arrangement of the lead coils on the inside of the kettles is primarily for maintaining the required degree of temperature for the best of the nitration.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14167) F. T. P. S. asks: What do you think of the theory advanced to me that the head of a comet is similar to a lens and that the tail is nothing more than some light passing through the head of the comet illuminating matter in space? Has this theory been advanced by any well-known astronomers? A. The facts do not support the theory of a comet's head and tail which you state as told to you. Many comets which come into our solar system do not at any time show any tail. No comet has a tail when remote from the sun. The tail often shows a dark space extending back through the tail as if the tail showed the shadow of the head though this is not the case. The appearance seems to be due to the form of the tail as a hollow cylinder. There is no appearance of a comet's tail such as would be produced by the action of the head as a lens, converging the light of the sun upon matter in space. The beam of light would then be seen as a straight beam always directed in a straight line as its axis away from the sun. As a matter of fact the tails of comets are usually curved. A good number of comets have had more than one tail. Cheseaux's comet in 1744 had many tails, some pictures show as many as ten tails. It would interest you to read Todd's New Astronomy, which we can send for $1.45 postpaid.

(14168) C. J. asks: According to the electron theory, a current of electricity is a stream of negatively charged particles flowing through a conductor. Bearing this in mind, would it not be correct to say that the current flows from the negatively charged zinc element to the positively charged copper element, in the case of the simple cell? A. The theory of the electric current held at the present time indicates, as some think, that the conventional direction of the current from the plus to the minus pole is not correct, but that the current flows from the negative to the positive pole. Still no one cares to change the old view. It does not affect the action of any apparatus or machine. Prof. Thompson in his latest revision of his Elementary Lessons, page 145, says, "No final evidence exists as to the direction in which a current in a wire really flows."

(14169) E. B. R. asks: At what temperature does "white frost" occur? One man argues that it occurs at 38 degrees, while another argues that while the temperature in the vicinity may be 38 or 40 deg., at the actual point at which "white frost" appears the temperature must get down to 32 degrees. A. Water does not freeze till the temperature of 32 deg. is reached where the frost appears. It may be several degrees higher near by, but where the frost is formed it must be as low as 32 deg. Fahr.

NEW BOOKS, ETC.

BRIDGE ENGINEERING, by Dr. J. A. L. Waddell, C. E., New York: John Wiley & Sons, 1916. 2 vols., cloth, 8vo. 2,177 pages, illustrated; price $10.00 net.

This handsome and very readable book is not merely an authoritative compendium of the design, fabrication, and erection of all types of modern bridges, it is also an authority on both the theoretical, ethical, and practical sides of the art and is really a complete library of bridge lore, amplifying the data presented several years ago by the same author in De Pontibus, supplemented by a vast amount of analytical work, record and details, from the large and varied practice of his own office and supplemented by authoritative information on all branches of the subject to make a veritable encyclopedia of the development to date of the most important branch of structural engineering, illustrated by many noted and typical examples.

The large number of valuable tables, records, and diagrams have been very carefully revised, arranged, and verified at a large expense by a number of specialists working under Dr. Waddell's personal direction and supervision. The book is equally valuable for reference and as a manual of design, fabrication, and construction.

There are 80 chapters abundantly illustrated with line engravings and half tones that fully cover the theoretical, practical, ethical and financial features of the art. The unusual readableness of this book happily distinguishes it from most technical writings and bears testimony to the author's ability of expression so frequently demonstrated in the proceedings of technical societies in this country and abroad. An added charm is also given by the

intimate treatment of a great number of important and difficult structures mentioned there, for which Dr. Waddell has been retained during his lifetime of active bridge design and construction.

The book begins with a brief history of the early days of bridge building and the development of the bridge specialist; treating the materials at his disposition and the requirements for loads, construction, and service. Complete and authoritative analyses and illustrations are given of the methods of calculation, secondary stresses, deflections, and the important principles of designing and detailing. The principal types of construction, such as cantilevers, suspension spans, independent spans, arches, elevated railroads, viaducts, bascules, girders, floor systems, the protection of steel work, and a consideration of wooden bridges, trestles, reinforced concrete spans, and general foundations are given, together with exceedingly valuable data not generally available for the determination of waterways, including a digest of 450 studies of rainfall and its effect on streams, an abstract of the requirement of the United States Government for bridging navigable waters, and a discussion of true economy in design.

The strictly practical chapters include foundations, cofferdams, open dredging process, pneumatic process, pile driving, piers and abutments, shore protection and mattress work, location and preliminary surveys, borings, hydrographic surveys, determination of layout, weight of steel superstructure, determination and estimate of quantities for substructures, unit costs and estimates, inspection, fabrication, erection, maintenance, and a set of advanced specifications for design and construction.

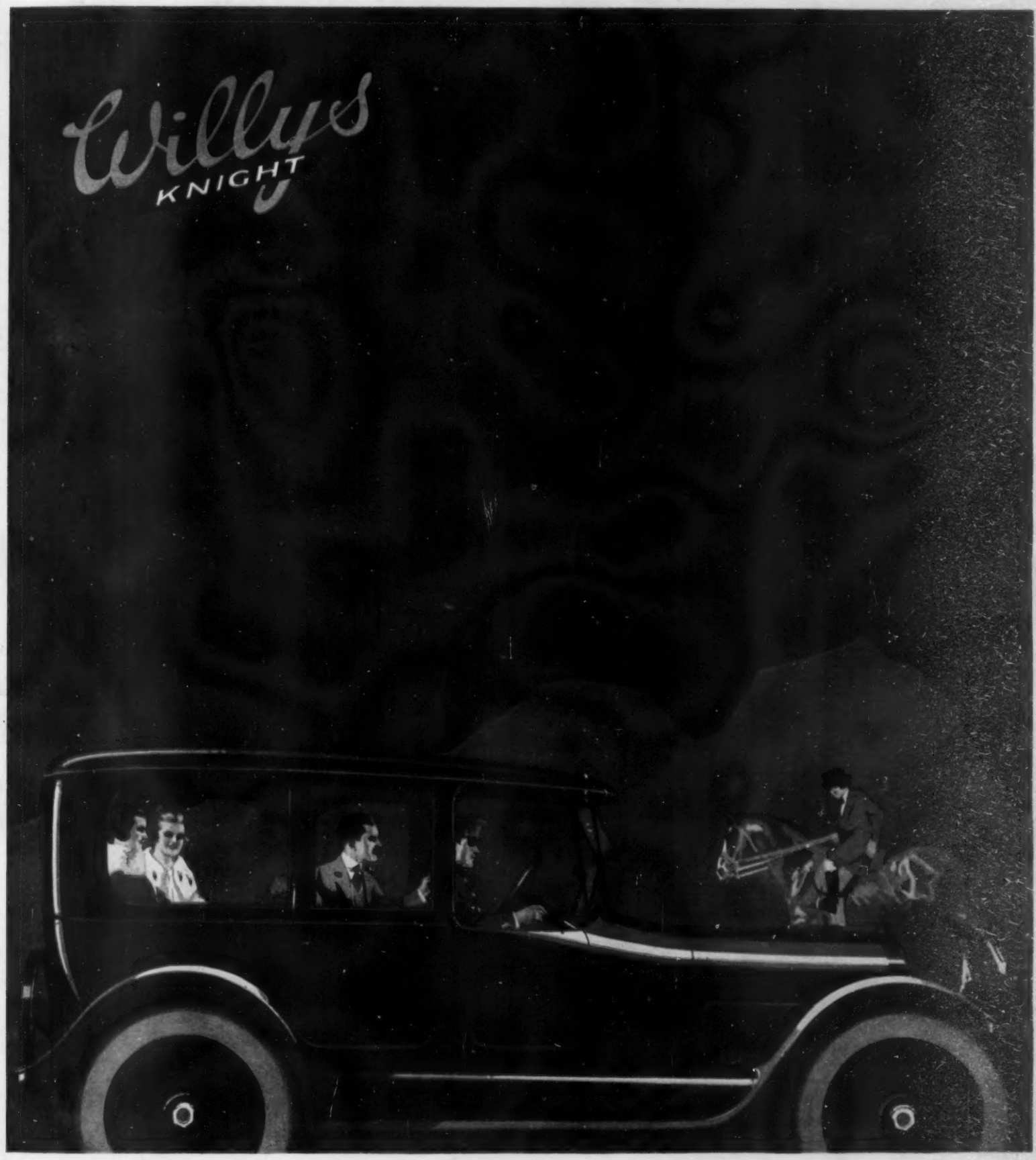
A very interesting chapter discusses bridge failures and another is devoted to æsthetics. Financial considerations are ably treated in chapters on contracts, reports, administration of construction, arbitration, promotion of bridge projects, and engineering fees.

Special information is given under the heading of Expedients in Design and Construction and on reconstruction, maintenance, and repairs of existing bridges. The ethics of bridge engineering are discussed under the duty of the bridge engineer to his profession, to his professional brethren, to his clients or employer, to his employees, to the contractors, to the public, and to himself. The glossary of about 4,500 technical terms with their definitions is intended to cover all the foreign phrases and technical terms used in the mathematics, designing, fabricating, erecting, maintaining and repairing of bridge work.

The book is no less than a liberal education in the wonderful development of bridge construction during the last 60 years, which has created entirely revolutionary types of structures and advanced the whole art to a degree of excellence that has been perfected to the lines of permanent standards and visible limitations fixed by the strength of materials now available, and the costs justified in construction. The data have been so admirably treated that while they are made easily usable for the unlearned practical man, and provide accepted standards and authoritative analyses and calculations for the expert, they are notably interesting and attractive to even a casual reader. The language is everywhere clear and eloquent and the typography so excellent that the book doubly merits the permanent position insured for it among the classics of technical literature in the working tools of the field engineer or contractor.

MODERN SHOP PRACTICE. Edited by Howard Monroe Raymond, B. S. Chicago: American Technical Society, 1916. Six vols; 8vo.; illustrated.

An exceedingly attractive and useful working library is offered the studious mechanic in these six volumes. It is pointed out that the mechanical evolution of the past hundred years has resulted in an accuracy and speed at least two hundred times that of a century ago, but that in this evolution the workman has become a specialist, and it is only by conscious and well-directed study that he can familiarize himself with shop activities other than those encountered in his own daily work. As a practical aid to the ambitious, "Modern Shop Practice" had stood the test of time, and the clear text and the two thousand engravings of its sixth edition elucidate the complex details of shop machinery and methods with a masterly simplicity. Each separate subject is handled by a writer whose experience and authority fully qualify him to instruct others. Vol. I treats of hand and power tools, gear cutting, turret lathes and screw machines, and modern production methods. Vol. II of machine shop management, metallurgy, welding, and die making and metal stamping. Vol. III of tool making and tool design. Vol. IV of foundry work and forging. Vol. V of pattern making and mechanical drawing, and Vol. VI of machine drawing and automobile shop work. Review questions and a detailed index are features of each volume.



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